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ANNUAL REPORT  
OF THE  
COMMISSIONER  
OF  
MINERAL STATISTICS  
OF THE  
STATE OF MICHIGAN,  
FOR 1881.



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BY AUTHORITY.

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OFFICE OF COMMISSIONER OF MINERAL STATISTICS, }  
Marquette, Michigan, August, 1882. }

HON. DAVID H. JEROME, *Governor of Michigan* :

SIR:—Herewith, in compliance with law, I have the honor to submit the annual report of the Commissioner of Mineral Statistics, for 1881.

It has been the aim to make the report as full and accurate as possible, and thus to include a description of all the mines in the State, with such details of product, methods of working, cost of production, etc., as are reliable and could be obtained. In this connection very full statistical information will be found in that portion of the report relating to the copper mines. Generally, in the copper district, the mining agents manifested an entire willingness to afford any information desired, and, in some instances, access was freely given to the company's books for this purpose.

The work has been done by Prof. C. D. Lawton, whose education and experience as a Mining Engineer, and connection with the preparation of previous reports, and with the earlier geological survey, eminently qualify him for the important task which he has performed.

Prof. Lawton has visited all of the copper, iron, and coal mines, gypsum and slate quarries in the State that are working, and has also examined and described many other localities where mines are being opened, and to which public interest is directed.

Sectional maps of many of the copper mines are included in the report, and have been marked up to January 1st, 1882.

The statistical tables will be found at the close of this volume. To them has been added a table showing the production of gypsum in the State for previous years down to the close of 1881, and also will be found a valuable table prepared by Dr. S. S. Garrigues, State Salt Inspector, showing, in like manner, the salt production of the State. The table showing the coal production has been made more complete than heretofore.

I have reported to the Auditor General of the State the amount of copper, iron ore, and coal, subject to a specific tax, produced by each mining company.

I am, very respectfully, your obedient servant,

CHAS. E. WRIGHT,  
*Commissioner.*





GYPSUM.



## GYPSUM QUARRIES.

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The gypsum deposits of Michigan, that are readily workable, are limited to a few localities, but fortunately they are at those points of sufficient extent and accessibility to suffice for all the demands that may be made upon them in the future. These beds, justly estimated among the most valuable of our mineral resources, belong to the carboniferous limestone series of the lower peninsula, but are not found to occur in the regular order of superposition, except in restricted districts; in many other places, having the same geological level, no indications of it are found. The most extensive of our known deposits of this mineral are found in the vicinity of Grand Rapids, in Kent county, in the western part of the State, and in the vicinity of Alabaster Point, in Iosco county, in the eastern margin of the State. At each of these localities is found a succession of thick beds of gypsum commencing near the surface, and aggregating many feet in depth. Plaster beds are also frequently met with in boring for salt, and in other borings where no beds were found, as in the Saginaw valley, its presence was detected by the large quantity of the gypsum, while the water held in solution a matter which, in such a connection, is very noticeable, from the fact that if the water, saturated with this mineral, is not shut off their pipes will become incrustated with it, and in a short time will be obstructed. Gypsum, in this form, was struck in the vicinity of Bay City at a depth of 700 feet, and at Kawkawlin the gypsum horizon was reached at about 400 feet below the surface. In the central portion of the peninsula no rock exposures of gypsum have been found, and neither here nor in the south part of the State have any gypsum deposits been discovered. This is a matter of small regret, however, since the deposits already known are sufficient to supply the demand for prepared gypsum were this demand to increase a hundred fold.

In the quarries of Smith, Bullard & Co., at Alabaster, the upper gypsum bed has a thickness of 16 feet, and borings which they have made at this point develop the existence of lower lying beds of an equal value, the second occurring but a few feet below the superficial bed. Commencing a few miles south from Alabaster point, along the shore of Lake Huron, may be observed the plaster beds which lie next above those found at the latter locality, and which rise above the surface, in bluffs, to the height of 20 feet to 30 feet. The product has not the purity, however, of that obtained at the Alabaster quarries. Near the head-waters of the Aux Gres river, extending west from Alabaster for nearly forty miles, gypsum is found near the surface of the soil; also to the north and to the south, and in many places in this vicinity are found large

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beds of rich gypsum; but it is at Grand Rapids that the product for consumption is principally obtained. Here the deposit is found to the south from the city a distance of about six miles, extending beyond the village of Grandville, and lying on both sides of the Grand river and beneath it, extending over an area of eight or ten square miles and lying from 2 feet to 70 feet beneath the surface. In this region the upper superficial bed has a thickness of 6 feet to 8 feet, and lies directly beneath the soil; then occurs a seam of soft slate about 1 foot in thickness, followed by a bed of pure gypsum 12 feet in thickness. The gypsum obtained either at Grand Rapids or at Alabaster does not vary materially in appearance or in quality. It is found of various shades of color, gray, brown, red, yellow, white, and mottled, like castile soap.

The prevailing colors are white, rose colored, and gray. Specimens are found made up of white and rose-colored crystals that are indeed very beautiful.

There have been many analyses made which substantially agree in fixing the the composition of the Michigan gypsum at

Sulphuric acid.....	46 pounds in 100 pounds.
Lime.....	33 pounds in 100 pounds.
Water of crystallization.....	21 pounds in 100 pounds.

Gypsum is formed wherever sulphuric acid comes in contact with carbonate of lime, and is also formed by the mutual decomposition of sulphuret of iron and limestone. In the arts it is generally known under the name of plaster of Paris, from the fact that extensive deposits of this mineral were early known to occur in the region of this city, in France, and the material was applied to many of the uses for which it is adapted. Alabaster is a pure granular form of this rock; pure alabaster is of a delicate white color and fine grain, and is susceptible of a fine polish. It was used by the ancient Greeks and Romans for the purpose of being wrought into ornamental forms. It is said to have been very extensively made into pots and boxes for perfumes, etc., in the vicinity of Alabastron, between the Red Sea and the river Nile, near which city the stone, in ancient times, was obtained, and from which it derived its name.

The ancient Greeks and Romans also understood its use as stucco, in the finishing of walls and in making casts. The *selenite* or crystalline forms, that present a mica-like cleavage into thin, semi-transparent planes, are said to have been early used instead of glass.

For its uses as stucco the gypsum must first undergo the process of calcination, which consists in first grinding the rock, reducing it to a fine powder, and then heating in kettles until the water is driven off. In the process of heating or "boiling" the material is kept constantly stirred, which, together with the escaping moisture, causes the mass to assume the bubbling appearance of boiling water. When the ebullition, due to escaping steam, ceases, the calcination is completed, though it may be subjected to a far higher degree of temperature without thereby lessening its ability to set. In France it is used for making floors as well as walls. In forming the paste or cement the process is simply one of restoring the moisture which has been expelled, and thus calcined gypsum rapidly absorbs moisture from the air and loses its value as a plaster; care has therefore to be taken to secure it from the air in packages that are rendered as impervious as may be, to the air. For the purpose of economy in saving the heat, and still more to prevent the escape and waste of

the powdered plaster, the kettles are enclosed in a chamber which is provided with suitable apparatus for absorbing, etc., the process of the calcination. In the Grand Rapids mills the arrangements for calcining are very elaborate and complete. When the calcining is completed, by raising a lever a gate is raised which opens an aperture in the side of the kettles adjacent to the bottom, through which the plaster escapes into a hopper-shaped bin, from which it passes into elevators that carry it up to the bolt, in which it is revolved, the sifted particles dropping upon and sliding down one or more inclined hollow sheet iron pans that are kept filled with water, a constant stream of cold water being directed into one of the upper corners of each pan and passed out from the lower corner upon the opposite side. The water bears away the heat of the sheet iron plates, which in turn absorbs the heat from the plaster, thus rendering it sufficiently cool to allow it to be passed into the chest, or along the carrying belts into the warehouse, or down the spouts into the barrels or bags in which it is conveyed to market.

With the exception, perhaps, for the purpose of making casts, the stucco from Grand Rapids is equal to any in the market. The claim which is made is probably a just one, that for finishing walls, etc., it is nowise inferior to the Nova Scotia product. It has recently been introduced to take the place of lime for both plain and ornamental plastering, and with excellent results, judging from the appearance of the walls which have been made of it and the rapid increase of its use for this purpose. The advantage of this kind of wall is, that when the material is good and the work is well done it is not liable to crack or crumble, or fall off, and is susceptible of a high polish. The beautiful frescoes in Italy, that for ages have challenged the admiration of the world, are upon the walls of stucco.

But the chief use to which gypsum is now devoted is of more modern origin and cannot be ascribed to the ancients. Its application to agriculture is the outgrowth of modern investigation, and it is by reason of its effects, which experience has proved to be so efficacious in promoting the fertility of our soils and the prosperity and happiness of the husbandman, that the rich and ample deposits of this valuable mineral in our State become of so much importance.

That plaster promotes the growth of very many plants in a great variety of soils is a fact too well established to need a moment's consideration; but in Michigan experience has shown that it is especially effective; its importance is so great as to render it almost the basis of successful agriculture. Taking into consideration our climate, our varied timber soils, so well adapted to clover and to wheat, the system of farming that prevails which includes wheat and clover among the most prominent of our products—it is more than probable that under such conditions as do exist that it is only by the free use of plaster that farming industry can be rendered fully prosperous. The abundance of our gypsum, its accessibility, and consequent cheapness cause it to become more and more freely used, and its efficacy in stimulating the growth of clover, which proves to be one of the most valuable of fertilizers as well as excellent for forage, enables the farmers of this State to maintain the fertility of their soil very easily and cheaply, even under a system which, without the abundant and free use of gypsum, would be ruinous.

Gypsum enters into the composition of grasses, potatoes, turnips, and many other plants, but it is probable it is not due to the fact that it enters as an ingredient into these plants that its manurial value is to be attributed. Its

action is secondary; the sulphuric acid which it largely contains acts, in a measure, as a disintegrator of the soil, of its mineral elements, putting it into conditions available for plant use. Aside from this, clover, somehow, possesses the power of supplying the soil with ammonia. A soil which a chemical analysis may show to be entirely deficient in ammonia will be found to be more or less fully supplied with this important compound after it has grown a crop of clover.

The most valuable constituent of a soil is nitrogen, an element which constitutes four-fifths of the atmosphere which we breathe, and which enters largely into the composition of the most valuable and nutritious of our vegetables. Those vegetables are the most nourishing to the animal system which contain it in the largest proportion, and those soils are the most productive which contain the proper amount of nitrogen in the requisite form to be taken up by the roots of plants, and nitrogen usually exists in the soil in the form of ammonia, a combination of nitrogen and hydrogen, the lightest of known substances, and one of the constituents of water, in the proportion of one part of the former with three parts of the latter. Both analysis and experience prove that clover, by supplying ammonia to the soil, instead of exhausting it, as most plants do, renders it richer. If the clover produced the ammonia from the soil in which it grew—used up that already contained in it—the soil might be weakened by thus perpetually using up those of its elements by which the ammonia was formed, but observation has shown that the clover obtains its ammonia from the atmosphere either by direct absorption, or by obtaining the nitrogen by absorption through its leaves from the atmosphere, and the requisite amount of hydrogen from the water taken up in the soil through its rootlets; then decomposing the water the free hydrogen unites with the nitrogen obtained from the atmosphere, thus forming within the plant the ammonia which it afterwards gives to the soil through the decay of its leaves, stems, and roots. Thus it is probable that the most important constituent of a fertile soil, which may be supplied in the growth of clover, is not abstracted by the plant from the soil itself, but that the plant derives it from the atmosphere and, arranging it, gives it to the soil in the form to be readily taken up by subsequent vegetation. That a soil grows constantly richer in productive qualities by growing large crops of clover, though crops of grain are taken from it in regular rotation, is a fact which the experience of many of the best farmers has proven. Hon. George Geddes, of Onondaga county, N. Y., one of the best practical farmers in America, has land which has been cropped for over 80 years, and has never received any other fertilizer than frequent dressings of plaster applied to growing clover, and this land, he states, is more productive to-day than when first put under the plow. No other manure has been used than clover and plaster. Thirty years ago his farm was visited by Prof. F. W. Johnston, a distinguished agricultural chemist of England, who expressed the opinion that his system would surely destroy his land; he thought that poorer land would have given out long before, and believed his must ultimately; but Mr. Geddes states that the same land is more productive than it was when visited by Prof. Johnston and he made his disparaging comments, and all the time the same system has been invariably adhered to. Such a result could not be obtained in any available way than by the use of gypsum applied to produce abundant crops of clover.

Leguminous plants, such as peas, also supply ammonia to the soil, probably by acting as a mulch and keeping the soil moist and open; in the same man-



ner clover doubtless acts, when heavy and lying in contact with the ground; the moisture hastens the decomposition of the under leaves of the clover, which in decaying give off hydrogen in the nascent state, in which condition it has a strong affinity for nitrogen, which it obtains from the air and with which it unites, forming ammonia that is rapidly absorbed by the moist earth.

But regardless of theory the fact remains that clover enriches the soil by supplying it with ammonia drawn from the atmosphere, and that plaster promotes the growth of clover in a wonderful manner. Thus it would seem that any soil may be rendered productive by growing clover, and nearly all soils, by a liberal use of plaster, may be made to grow clover.

It is probable, also, that plaster tends to increase the moisture of the surface of the ground, acting as above mentioned regarding the clover, in acting as a mulch, *i. e.* the moisture hastens decomposition of vegetable matter near the surface and in the ground. This matter, in decaying, gives off free hydrogen, which in turn unites with the free nitrogen in the atmosphere, forming ammonia, which is absorbed by the ground. Other plants besides clover are greatly stimulated in growth by the application of plaster, but in the clover we have in addition to its value for hay and pasture its use as the cheapest of all known fertilizers. Land plaster was prepared at Grand Rapids in the early settlement of that section, and has since continued to be manufactured with increasing facilities. A crude little mill was erected not far from the site of the mills of the present Grand Rapids Plaster Company, in 1845, by R. E. Butterworth, which was run by water, when the first plaster was ground. The farmers in the vicinity began using it, and gradually customers came in from greater distances, and thus the territory to be supplied soon widened, so that in the winter season, when good sleighing prevailed and after the facilities for grinding had been increased, teams came from long distances in the south part of the State and from Indiana in great numbers to Grand Rapids for the plaster. The plaster also began to be shipped to other points by boat via the Grand River, which is navigable from Lake Michigan to the plaster beds for light draft vessels.

Across the lake, in Wisconsin, a market was opened for the plaster; mills were erected there, and much of the product was supplied to them in the unground state. The shipping of the unprepared rock has all been done away with at Grand Rapids, for since the building of the immense mills and calcinal works and warehouses which they now have there, their facilities have become so elaborate and complete as to enable the companies to effect the preparation much more perfectly and cheaply than it can be done elsewhere, either of stucco or of land plaster. From Alabaster the rock direct from the quarry is shipped to several points in Michigan, Ohio, and Canada, to supply mills which prepare it for consumption.

The use of plaster upon the farms in this State has greatly increased, but it is doubtful if the merits of this valuable and now so easily to be obtained fertilizer are yet everywhere fully appreciated; its free use as an absorbent will be found to be greatly to the farmer's advantage, applied to the manure heap, to the barnyard and stable; it will absorb the escaping ammonia, and subsequently, in the decay of manure, after being spread upon the land, will relinquish it to the use of the growing plants.

Several railroads now concentrated at Grand Rapids, and these, together with the water communication afforded by Grand River into Lake Michigan,

furnish avenues for transportation to all portions of the State and country. From supplying the adjacent farms with a few tons annually of land plaster, the business has constantly radiated wider and wider until now it embraces the west and the southern States within the circle of the territory which draws from here its supply of gypsum. Car loads of land and calcined plaster are almost daily shipped to Omaha, St. Louis, Nashville, Louisville, New Orleans, or other points in the west and south. In the latter section of the country an important trade is springing up that bids fair to grow into a wide market for this commodity. Applications of plaster have been found to be very efficacious in promoting the growth of the cotton plant.

The gypsum deposits at Grand Rapids, in the quarries where they are worked, have a dip, slightly, to the northeast and east; the formation appears to roll, somewhat, though no faults are observable. Aside from what may be observed in the quarries, the extent of the gypsum deposits, as well as character and thickness of the rocks with which they are associated, is indicated by the results of a drill hole made by Messrs. Godfrey & Bro., at their quarry near the south line of the city limit, on the southeasterly side of the Grand River and near the mouth of Plaster Creek. This boring was made for the purpose of accurately determining the nature and thickness of the underlying rock beds, and careful examinations were made and a record kept of the results. The boring only extended to a depth of ninety-eight feet, and shows an aggregate thickness of fifty-seven feet of the plaster beds that were successively intercepted. The record is as follows, the boring having been made in 1876:

	Feet.		Feet.
Earth stripping.....	20	Gypsum.....	81½
Gypsum.....	8	Slate—shale.....	31½
Soft shale—slate.....	1	Gypsum.....	121½
Gypsum.....	12	Shale, or clay slate.....	11½
Shale, or clay slate.....	7	Gypsum.....	91½
Gypsum.....	61½		
Shale—clay slate.....	8	Total.....	98

Other borings have been made for salt and for the purpose of obtaining flowing wells, but generally no record was kept or the examinations were so loosely made that in most instances the data are not very reliable. The determinations above given were made by Mr. Freeman Godfrey, a gentleman of much intelligence and of long residence in this city, who also superintended the boring.

Thus far none but the two upper beds have been worked, and probably several generations will have succeeded one another before the necessity shall arise for resorting to the lower deposits for a supply of gypsum.

I have succeeded, with the assistance of the late Wm. Hovey, who, up to the time of his death in November last, had been agent of the Grand Rapids Company since 1860, and who was also familiar with what had been done here in this business prior to that period, and the Messrs. Godfrey, who have also been engaged in the plaster business during a long period, in compiling the statistics of the product of the quarries of Kent county up to the present time. A complete table of the statistics of the Grand Rapids Plaster Company will be found in connection with the description of that company's works, as will also be found the product for recent years of other companies in connection with the account of their quarries, etc. For the ten years prior to 1866 the total product of land plaster is estimated at 100,000 tons.

PRODUCT OF LAND PLASTER.

	Tons.		Tons.
1866.....	14,604	1875.....	27,019
1867.....	17,439	1876.....	29,131
1868.....	28,837	1877.....	40,000
1869.....	29,996	1878.....	40,000
1870.....	31,437	1879.....	44,667
1871.....	41,126	1880.....	48,070
1872.....	43,536	1881.....	32,720
1873.....	44,973		
1874.....	39,126	Total.....	652,680

The falling off in the product of 1881 was due to the severe winter and late spring that prevailed throughout the country, causing the farmers to be unusually behindhand in their work, and thus preventing them from obtaining their customary supply of plaster. The weather also obstructed the companies in the matter of shipping and promptly filling orders.

The manufacture of stucco or calcined plaster began about 1860, and up to 1868 the total number of barrels of stucco produced was about 80,000.

From 1868 to 1881 the total number of barrels of stucco manufactured was 1,076,656, as follows:

	Barrels.		Barrels.
1868.....	34,966	1876.....	64,386
1869.....	41,187	1877.....	55,000
1870.....	46,179	1878.....	48,346
1871.....	48,685	1879.....	50,800
1872.....	59,767	1880.....	106,004
1873.....	82,453	1881.....	112,813
1874.....	82,949		
1875.....	61,120	Total.....	1,076,656

A barrel of stucco weighs about 300 pounds. They reckon seven barrels to the ton.

For several years prior to 1880 a good deal of competition existed among the manufacturers of land and calcined plaster, particularly in the land plaster trade, which resulted in bringing the price down below the cost of production, causing the financial failure of some of the parties who were engaged in the business; this has naturally led to a reorganization of the plaster trade upon a basis that divides the entire production equably among those engaged in the manufacture. The price fixed upon each year is one that leaves a moderate profit to the producer, and treats all consumers alike.

The agreement entered into by the manufacturers fixes the price of land plaster, delivered into the general market, at \$3.00 per ton at Grand Rapids. There is one exception to this price. Loren Day, representing the Wyoming quarry and mills—the Grange quarry, as it is sometimes called—sells in Michigan at \$2.50 per ton. In the arrangement which he has made with the other companies he is allowed to sell, at this rate, only one-fifth of the total product of all the quarries; if his sales exceed the one-fifth of the product, he is to pay on the excess, fifty cents per ton, the amount to be proportioned and divided among the other companies. Considerable friction must naturally attend such a difference in price, but it is claimed that \$3.00 per ton is as low as the plaster can be afforded. In this arrangement are also included Marsh & Co., of Ohio, and Smith, Bullard & Co., of Alabaster, Mich.

The price of the stucco is placed at \$1.50 per barrel, and freight to Chicago is now 17 cents per barrel; formerly the freight was 45 cents, a great reduc-



tion, which shows the advantages which any manufacturing business possesses when provided with competing lines of transportation.

### GRAND RAPIDS PLASTER COMPANY.

The Grand Rapids Plaster Company was organized in 1860, under the general laws of Michigan, with a capital stock of \$125,000, divided into shares of \$25 each. The company, however, began the work of mining and of grinding plaster rock in 1856, and up to the period of its organization as a corporation it had produced about 25,000 tons of land plaster and stucco. The product subsequently produced by this company since 1860 is shown in the following table, for each year, furnished to me by Mr. Hovey, the agent, from the books of the company:

Years.	No. of Tons Quarried.	No. of Tons Land Plaster.	No. Barrels Stucco.
1861.....	8,131	7,828	1,840
1862.....	9,223	9,223	4,357
1863.....	13,703	13,555	6,894
1864.....	15,059	13,260	10,785
1865.....	12,146	10,008	12,828
1866.....	9,424	6,546	17,268
1867.....	7,771	5,158	15,682
1868.....	9,421	5,842	21,477
1869.....	12,670	8,193	26,710
1870.....	10,502	7,231	19,624
1871.....	11,639	8,224	20,494
1872.....	17,081	13,333	22,491
1873.....	20,270	13,690	39,485
1874.....	15,365	8,803	39,376
1875.....	10,075	6,171	23,432
1876.....	8,510	5,411	18,298
1877.....	9,408	6,582	14,740
1878.....	10,440	8,286	12,925
1879.....	10,960	8,970	13,270
1880.....	15,525	12,000	23,500
1881.....	9,815	6,775	20,400
Totals.....	246,138	184,079	385,877

The location of the company's quarry and works is about one and one-half miles south of the city, on the northwest side of the Grand River, where the company owns one hundred and seventy-eight acres of land. The surface improvements, comprising the plaster mill, calcining works, extensive warehouses, etc., all of the most substantial kind and provided with every appliance for economical working and for producing the best material, were all consumed by fire in May, 1880. They have since been rebuilt, and the new structures and new works are in every respect equal to those which were destroyed. These buildings are situated just east of the bluff, which extends northerly and southerly, parallel with the river, which latter lies about 300 feet to the east. At the foot of the bluff two beds of gypsum are exposed, partly composed of white, and rose-colored granular gypsum with gray and mottled portions of the same material. There is mingled with it also some impurities, consisting of gray limestone cemented with brecciated gypsum which, when occurring, is rejected. Separating the gypsum from the slate



are thin seams of very pure translucent selenite. The mine is opened by three inclined shafts extending from the base of the bluff to the bottom of the mine. The underground workings extend about fifty rods from the mouth of the shaft, and comprise an area of about sixteen acres, worked out to a depth of 12 feet, leaving a roof of 8 feet of gypsum, with a superincumbent depth of earth of about 60 feet. The roof is supported by substantial pillars of the mineral, which are left about 30 feet apart and are about 16 feet in diameter; between these pillars the roof is secured by upright timbers 20 inches to 3 feet in diameter, of white oak, judiciously placed so as to insure perfect safety. So well has this matter been attended to that no fall of the roof has ever occurred in the mine, and no cracks or other indications of danger are anywhere observable. Between the gypsum bed, which is worked out, and the deposit, which forms the roof, is a stratum of friable slate-colored shale, 1 foot in thickness, and separating this from the two plaster beds above and below it is the thin seam of colorless selenite previously spoken of. This slaty bed is removed and left on the floor, as is also other refuse rock that it is deemed necessary to waste. The mine is dry and apparently free from dampness; not a drop of water finds ingress except the little which in rain fall, or arising from melting snow, runs down the shaft; this is drawn off into a sump and pumped out, as occasion requires. One or two leaks have been opened in the mine, but they have been effectually stopped. In one instance, a brick wall, built a few feet inside from the side of the wall where a serious leak had been opened, and the intervening space securely packed with clay, completely shut off the water, which has since given no trouble.

Tram roads extend to all parts of the mine which it is necessary to reach with the cars. Good wooden rails are used, laid with a gauge of three feet seven inches. The road is provided with switches and turn tables to change the direction of the cars as required, and contented-faced mules haul them to and fro over the railroads to and from the foot of the incline shaft, up and down which they are raised or lowered with a chain winding over a drum, connected with the engine. One of the skip roads terminates in the mill, on the floor where the crusher is placed, and another track runs out upon the surface of the ground and extends to the river. This road is used for running the carloads of rock from the mine to the boats, whenever gypsum is shipped in the unprepared state, as was formerly done to considerable extent, the rock going to supply mills in Wisconsin, where it was ground. The timbers necessary for supports in the mine, and other heavy materials are taken in or out on this track.

The method of mining pursued consists in taking down the rock from the roof half way to the bottom, and carrying forward this work of removal of the deposit for a considerable distance, the roof being supported by short stalls, which are afterwards taken away and are replaced by permanent supports. A bench or breast of gypsum, 6 feet high, is thus left, which in turn is stoped away, the selected rock removed to the surface, the timbers put into place and the bottom hauled up with the refuse. The rock is soft and easily drilled and blasted; powder is the only explosive employed, and the charges used are from three to five pounds. In this work of mining eleven miners only are kept constantly employed.

The quarry is lighted with gas, which is manufactured in the mine and conveyed to the lamps, in which it is burned, through rubber tubing. About eighteen barrels of gasoline are yearly consumed in manufacturing the gas for lighting this mine; these are kept, for safety, in tanks filled with water.

An examination of this subterranean quarry is simply a pleasant pastime. It is so easy to enter, so level and dry, so airy and comfortable, so free from impediments in traversing it, so well supported and devoid of danger, so full of interest, too, as an important practical industry, with enough of the unseen and mysterious to stimulate the imagination of the novice as to render a visit to this artificial cavern a delight to any who may be so fortunate as to enjoy the opportunity of making it.

The cars have a capacity of conveying about four tons of rock, and when drawn up into the mill the material is unloaded by being thrown, by the men, piece by piece, into the crusher, which breaks it up sufficiently fine for the pulverizer, a strong, iron coffee mill-like machine, which works by an upright iron shaft, and is placed on a level with the floor, directly beneath the vent of the crusher. In this it is broken up to a maximum size of a hickory nut, and is carried in the conveyors, precisely like those employed in flouring mills, to the hoppers of the grinding stone, which are French burrs, 42 inches in diameter, and of which there are four; two of which, only, are usually kept running, and these have a capacity of eleven tons per hour. This is the final reduction, as the stone pulverizes the material to the fineness necessary for land plaster or for subsequent calcination, for stucco. From the burrs the ground plaster is elevated in the closed conveyors and discharged upon a broad belt which moves horizontally, supported on small wooden rollers fixed at a few feet apart. The plaster is thus carried from the mill to the calcining building, with which it is connected by an elevated covered way. This carrying-belt is made to discharge upon a similar belt running at right angles with it, which conveys the plaster to the long warehouse. If desired the belt is made to discharge so as to be drawn from a spout, extending down near to the floor in the room below, into bags for shipment. The cut-off is effected by giving a twist to the long carrying belt, causing the plaster to discharge at the point where the twist is made; by this means the plaster is caused to be deposited with any degree of uniformity upon the floor of the store room. At the extreme end of the conveyor is a spout directly over the scales, into which the plaster may be discharged, and thence drawn into a car, the car standing on the scales. The load is then run into the car standing upon the railroad track, which runs alongside the warehouse. The arrangements suffice for loading several cars at the same time, from the doors of the long warehouse, which open upon the track.

The plaster ground for stucco in the same manner passes into the building and is conveyed to the bin adjacent to the kettles, into which it is drawn as required. The boiling is done in what is known as the Powers kettle; the ones here used are 8 feet in diameter, and hold about 14 barrels at a charge. Formerly a good deal of trouble was experienced in the matter of kettles, to obtain such as would hold and not by reason of leakage allow the moisture to escape at the bottom, and thus interfere with the fires. The Powers kettle is the result of many failures by other inventors, and is thought to work admirably. The fires are fed beneath the kettles, the flames and heat enveloping the kettle, and also passing through it, through an 8-inch flue, which is covered by the boiling mass. Paddles, revolving horizontally, assist in securing the commotion and insure the rapid escape of the moisture, which is conducted into the tall chimney through which also escapes the smoke of the fires. The time occupied in the calcining process is about three hours, and when completed the gate in the bottom of the kettle is raised by means of a lever, and the kettle almost instantaneously empties itself into the large brick hopper

shaped bin, from which the elevating cups transmit the hot stucco to the bolts from which the sifted particles fall upon the inclined cooling pans, from which it falls into the chest beneath, from which it is conveyed on the broad carrying belts into the great warehouse, where it is stored and packed into barrels and paper sacks for shipment.

Although there is naturally much dust floating in the air, yet the men who for many years have been engaged in the business claim that it is healthy, and that no apparently injurious consequences arise from breathing the dust-laden air. In hot weather, in the summer, the heated particles of stucco falling upon the skin are not so agreeable, but in cold weather the work about the kettles is not unpleasant.

The motive power is furnished by three large steam boilers, which are fed from an elevated spring, from which also flows the water that is used in the cooling pans. The engine is an 18x26 cylinder. Shipments are made by rail or by water, as desired. The branch railroad connects with the Lake Shore & Michigan Southern Railroad, but shipments can be sent on any of the other roads by paying two dollars per car trackage.

The buildings are all new, substantial and extensive, and all of the appurtenances are of the latest and most approved patterns. As in the quarry so upon the surface, everything betokens the best of management and most careful attention to secure the best results.

Since the death of Mr. Wm. Hovey, who had been the company's agent since its organization, the charge of affairs has devolved upon his son. Mr. A. M. Apced, the present superintendent of the works, has also held that position in this company for many years, and it is very apparent that the confidence in his ability as a manager, which is shown by this long retention in the service of the company, is well merited.

Further down the river, about one-third of a mile distant to the southwest from the quarry of the Grand Rapids Company, are the mine and works of

#### NOBLE & CO.,

Successors of Taylor & McRingolds. Here also the quarry is entirely underground, extending, as in the former case, to the northwest, beneath the bluff on the northwest side of the river. The north line of the underground workings is close to the line between the properties. In several places, in the Noble quarry, this line has been crossed.

The quarry is entered by two shafts, or inclined skip roads, one extending up into the mill, which, as in the former case, stands close to the opening, and the other running out upon the surface to convey rock to the river, to carry out refuse, and to run in timbers and other materials into the mine. The deposit is like, in all respects, that in the Grand Rapids Company's quarry, and the method pursued in mining the rock is altogether similar to that heretofore described. The underground excavations extend over an area of about seven acres.

Recently, an apparently serious misfortune has been met with, which is occasioning a good deal of present expenditure and greatly retarding the work of production. The roof of the entire interior portion of the mine has fallen in; an area of about five acres is thus buried in ruins. The cause was due to failure to sustain the roof properly. The pillars were left too wide apart, and an insufficient number of timbers put in. One result of this catastrophe, which is, perhaps, more troublesome than any other, is the number of leaks



that have been opened, which cause, in the aggregate, a considerable water accumulation in the mine, and necessitating drainage and the work of a heavy pump for its removal. For this work a 10-inch Knowls pump has been placed in a recess near the west entrance to the mine, and is supplied with steam from the main engine boilers. The plan is to drive a gallery around on two sides of the old workings and thus open a new quarry to the south and west of them, leaving sufficient pillars between it and the ruined portion. As the part which has fallen in was already practically worked out there is perhaps no great loss, in the long run, in thus being forced to abandon it. Except for the present delay and the increase of water the fall, it would seem, need not be esteemed a very serious misfortune. The quarry will soon be in shape to afford its accustomed product.

The rock is drawn up from the quarry upon the floor of the crusher where, after passing through the crusher and the pulverizer, it is ground to fineness in a vertical iron mill situated on the floor below, and thence elevated to the bolt, of which there are two, one for stucco, and one for land plaster as well, the imperfect work of the mill rendering it necessary that the land plaster should be sifted after being ground. Thus prepared the plaster is conveyed to the warehouse on the long belt carrier and deposited as required. A new warehouse has been built within the past year. The building is three hundred feet in length and first-class, for the purpose.

The stucco works comprises three kettles for calcining, one kettle having been recently added. The branch to the Lake Shore & Michigan Southern Railroad extends alongside of the warehouse, and every facility is provided for rapidly loading the cars; a track also runs to the river for shipping by boat. The company owns forty-six acres of land.

The operations are controlled by Noble & Co., Grand Rapids, Michigan, and the superintendent of the works is J. A. Hurd. The product for each of the three past years is as follows—for the years prior to those given, the product is incorporated with those of the other companies, which aggregates have been heretofore stated :

Years.	No. Tons Land Plaster Sold.	No. Barrels of Stucco Sold.
1879.....	10,585	12,560
1880.....	9,570	24,504
1881.....	6,772	30,000

#### F. GODFREY & BRO'S. QUARRY AND WORKS.

On the opposite side of the river, southeast of the quarries previously described, are the important and long established quarries and works of the Messrs. F. Godfrey & Brother, who began here in 1861 and have since continuously produced plaster and stucco for market. The works are just outside of the city limits and the parties own several hundred acres of land. An excellent road—a pleasantly shaded summer drive—runs along the southeast bank of the river, between the works and the heart of the city. The rock is mined in an open quarry, situated a short distance east of the river. The deposit dips slightly to the north, and the ground also rises in that direction, which has occasioned the abandonment of the quarry first opened to the north, to avoid the increase of “stripping.” A new opening was made south of the old one,



and in this the gypsum is now quarried. It was in this latter quarry that the boring was made, an account of which has been heretofore given.

The deposit is here covered with about 20 feet of earth, which has first to be removed, and the gypsum, to the depth of 20 feet—in two beds, 8 feet, and 12 feet, separated by 1 foot of shale—is taken out.

The quarrying is done in dry weather in summer, when there is the least water; during the remainder of the year the quarry is filled with water up to about the level of the earth stripping. At the proper time the water is pumped out, the superincumbent earth stripped away, and the work of quarrying begun. Holes are drilled through the entire depth of the deposit, and blasts inserted which loosen up from fifty tons to one hundred and fifty tons of rock at a single explosion. The rock is removed and stored under long sheds that suffice to hold several thousand tons each. Rock sufficient for the anticipated business of the ensuing year is thus gotten out and sorted for the manufacture of stucco and for land plaster. There is no practical difference, as shown by analysis, in the fertilizing value of the different grades of gypsum obtained in the Grand Rapids quarries. In selecting for calcining, the choice is determined by the hardness and grit, qualities essential to suitable stucco plaster. The product, as it comes from the quarry, is remarkably free from extraneous rock, and the deposits are of such unlimited extent, and are so easily mined that there could be but little gain in using impure rock, so that there would seem to be but little necessity or inducement for using worthless material in the manufacture of either land plaster or stucco.

Besides the difficulty of grinding the calcareous, flinty, or slaty material as compared to the soft gypsum would occasion a degree of injury or an increased wear of the mill stones, that it alone necessitates care in assorting.

The mill, calcining works, warehouses, etc., are close to the quarry, between it and the river. Both water and steam power are provided; the former is furnished by Plaster Creek, and formerly sufficient for the purpose of grinding, etc., but an increase of business and a diminution of water rendered necessary the added power of an engine. Mr. Godfrey contemplates putting in a new water wheel and otherwise improving the water power when he thinks it will nearly, or quite, enable them to dispense with the engine. The pump which is used in unwatering the quarry is operated from the water wheel. The crusher is an upright, double concern, with heavy cross lever above, the parts acting alternately, one jaw opening as the other closes. The rock from the crusher passes through the rollers beneath, which pulverize it for the burrs, from which it is carried on the broad belts to the land plaster warehouse or to the calcining works, as desired.

The calcining works are new, having been built within the past year, and the long experience of the Messrs. Godfrey has enabled them to build to the best advantage. The works are of a substantial character, and are calculated to secure the best product in the most economical manner. There are two kettles, each 10 feet diameter, with a combined capacity of one hundred and twenty barrels in ten hours work. Their aim was, in constructing these works, to secure such as should excel in every essential particular. The warehouse for calcined plaster is about 80 feet by 200 feet in size, and upon the opposite side of the calcine works, extending nearly to the river, is the land plaster warehouse, which is 180 feet by 100 feet; side tracks connecting with a branch of the Western Michigan Railroad pass along both sides of the warehouses, and the transferring of plaster or stucco to the cars is facilitated by such contrivances as are found to materially lighten the labor. The river is so

near that shipping by boat occasions but little additional trouble. Shipment by rail or by boat is governed by the matter of cost. The railroads are obliged to conform to the water rates. The river has usually a large volume of water. A recent government survey determined the fall of the river, from the mouth to the rapids, to be 7 feet. The navigation has been materially improved by the government dredges in late years, and further work of this kind could make this an important thoroughfare for Grand Rapids. The shipments from the works of Godfrey & Brother since 1878, are as follows. For the prior years their product is included in the general results heretofore given.

Years.	No. Tons of Land Plaster Shipped.	No. Barrels of Stucco Shipped.
1879.....	9,117	13,000
1880.....	9,000	23,000
1881.....	6,422	27,500

#### GYPSUM GRANDVILLE QUARRIES—UNION MILLS.

At Grandville, four miles from Grand Rapids, are found important quarries and accessory works,—The Union Mills Company, and the Wyoming Plaster Mills, the latter known as Day & Taylor, now controlled by Loren Day.

The Union Mills comprises the property lately possessed by the Union Mutual Life Insurance Company, and consists of two adjoining concerns, the one having forty acres of land and the other eighty acres, with a quarry and a mill upon each. The Insurance Company came into possession of the property through the foreclosure of a mortgage that had been given as security for money that was borrowed to construct the buildings. In 1878 the insurance company decided to operate the quarries, and Mr. T. N. Brosnan was appointed agent. In August, 1880, Messrs. Brosnan and J. C. McKee purchased the property and continued the work of mining and manufacturing plaster and stucco. On November 26, 1881, articles of incorporation were entered into under the title of

#### UNION MILLS PLASTER COMPANY,

With a capital stock of \$150,000, divided into shares of \$25 each. Both mills are in excellent order and provided with every appurtenance and convenience for effective and economical working. The mills are nearly opposite each other upon either side of the road. That known as the red mill on the west side of the highway is a large four-story building, furnished with three French burrs, 42 inches diameter, fed from the spouts that connect with the crusher. They have a capacity for crushing and grinding one hundred and twenty tons per day. The engine is unusually powerful for the purpose it serves, 22x30 cylinder, with three 30-foot boilers. The ground plaster is conveyed on the endless belts from the mill to the calcining room or to the warehouse, as required. The burrs, carrying belts, elevators, etc., are readily thrown into or out of gear at the pleasure of the foreman, without interfering with the engine. The workmen upon the distant warehouse floor can, at will, cause the long carrying belt to deposit its burden so that they may draw it from

the spouts into bags for immediate shipment. Much of the land plaster going to distant markets is shipped in bags.

For calcining there are in this establishment three kettles, each 8 feet diameter, similar to those already described. Three hours are necessary in heating a batch, and the mass is run out at the aperture at the bottom, by raising the lever that removes the gate, which covers it. The three kettles have a capacity of one hundred and forty barrels per day. When sufficiently boiled, and emptied into the cooler the plaster is elevated to the bolt and there sifted upon the cooling pans, which are filled with water by a force pump connected with the engine; the hot water from the pans is conducted back to the boilers.

The bottom of the kettles is 4 feet above the grates; the fuel used in the heating is soft coal, of which twenty-three pounds are consumed to a barrel of stucco.

To the west a short distance from this mill is an open quarry, which is not worked, all the rock being derived from the quarry near the opposite mill. It is not deemed economical to work both quarries, as one suffices and less pumping is required.

The quarry from which the rock is now taken out is the one on the east side of the road, a short distance to the southeast of the large white mill. The gypsum deposit is covered by from 5 feet to 8 feet of dirt, which is stripped away and the rock mined out to a depth of 12 feet. The mining is done in the summer season, the water being then pumped out, the steam pump being placed in a small building close to the edge of the quarry. The rock is very uniform in appearance and very pure, free from all extraneous matter. It is stored in long sheds, of which there are five, situated parallel to each other and close to the quarry and to the mill. The rock is thus covered from the weather and is comparatively dry when taken into the mill to be manufactured. It is sorted when taken from the quarry, and that intended for calcining is placed in separate sheds. The white mill, with the calcining works and warehouses, all joined together and constituting one building, is 400 feet in length, substantially built and nearly new.

The machinery, calcining kettles, and arches, carriers, etc., are all in excellent order and everything works admirably. The two mills, worked to their full capacity, would enable the company to make a large out-put, greater than any other company in the business. The demand for the product, with a margin of profit, is all that is needed to make the Union Mills Company a prosperous concern.

Side tracks along by the warehouse, etc., connect with the Western Michigan Railroad, and at the time of my visit a number of cars were being loaded for Tennessee. Orders were also shown me for land plaster to be shipped to Louisiana. A small stream near by, which empties into Grand River, suffices for carrying off the water, which is pumped from the quarries. The company have a number of dwellings on the property, also an office, store, etc.; the land is cultivated for farm products, for which it is well adapted. The stucco for the new court house and the city hall in Chicago, the Southern Hotel in St. Louis, and for the new chamber of commerce at Milwaukee, was produced at these mills.

During the year 1881 5,500 tons of land plaster from these mills were shipped into Wisconsin, and 1,500 tons of stucco were sold to a plate glass company. In the manufacture of plate glass the stucco is used for making a perfectly flat and smooth bed on which to grind and polish the plates of glass.



The general office of the company is at Grand Rapids, Brosnan & McKee, agents. The foreman of the mills is Mr. D. W. C. Blackmer, who is a very competent man for his position, having had many years' experience in the business.

The product of the mills since 1878 is given below. The amounts produced in previous years is included in the general statement of products heretofore given.

Years.	No. Tons of Land Plaster Sold.	No. Barrels of Stucco Sold.
1879.....	4,500	
1880.....	7,500	35,000
1881.....	6,077	34,913

### WYOMING PLASTER MILLS.

About three hundred feet north from the east quarry of the Union Mills company is the quarry of Loren Day, known as the Wyoming Mills quarry, or the Grange quarry, formerly conducted by Messrs. Day and Taylor.

The deposit is the continuation of that just described, and is in all respects similar, covered with about the same thickness of drift.

The rock, however, has to be transported a distance of about one-third of a mile to the mills, which are located west of the quarry. A railroad track is laid from the quarry to the mills on which the cars are run to carry the rock. Near the mills are the sheds in which it is stored to await being ground into plaster.

The mill is run by water power, there being sufficient water for grinding during most of the year. The arrangements for grinding and disposing of the plaster are similar to those at the Union Mills. There are three burrs, and the ground plaster is carried by the long belt conductors into the immense warehouse which adjoins the mill on the north, where is found every facility for storing and handling an almost unlimited product.

Heretofore this concern has manufactured no stucco, but recently the arches and kettles and other appurtenances for calcining have been put in and are now ready for use.

The kettles are two in number, with wood furnaces for heating. The preparations would seem to warrant the assumption that the company will manufacture a first-class article of stucco. The location is a pleasant one, and the exterior and interior arrangements indicate a good degree of convenience.

Some years ago an arrangement was made with the State Grange Society whereby this company furnished its plaster at a considerable reduction in price, and the assertion has not unfrequently been made by prominent agriculturists, that the land plaster made at this mill was intrinsically more valuable than that produced at the other quarries. It has been claimed that more pains was taken to store the rock and preserve it from the snow and rain, thus making the plaster dryer; also, that as no rock was assorted out for stucco, the average rock was richer. So far as my observation goes, from the visits that I have made among the quarries, I judge that there is the requisite degree of protection given to the rock at all the mills, and an equal amount of care shown in casting out impurities. The rock, when it is not taken from



subterranean quarries directly into the mill, thus being never exposed to the weather, is placed under cover at all the quarries. The essential compound which gives to land plaster its value as a fertilizer is, undoubtedly, the sulphuric acid which it contains, which is an egredient that is not so all important in stucco. It does not appear that the rock which is ground for stucco is richer in sulphuric acid than that which is taken for fertilizer. The choice, as heretofore stated, is based upon the color, hardness, and grit—qualities which experience quickly detects.

In future, any claim of superior quality of product from the fact that no stucco is made will be altogether set aside from the fact that all the companies are now engaged in its manufacture.

I judge that dealers or farmers procuring either stucco or plaster can do so with entire confidence that from whichever of the companies they may obtain these products, they are assured of a good article. The choice, if any they may have, should be governed by other considerations than that of apprehension of receiving an inferior quality of gypsum in whatever form it is sent out.

The annual product for the years here given is as follows. The product of the previous years is added in with that of the other companies, and is therefore contained in the aggregate product for the different years heretofore given:

Years.	No. Tons of Land Plaster.	No. Tons of Stucco.
1879.....	7,000	None.
1880.....	10,000	None.
1881.....	6,093	None.

Office of the company, Grandville, Kent county, Mich. Loren Day, agent.

#### ALABASTINE.

Near the Wyoming mills are the works of the Grand Rapids Alabastine Company. Alabastine, so called, is the name given to a cement for wall finish, applied to plastered walls, to wood or brick. It is made from stucco, or rather stucco constitutes the chief ingredient, and is made of a variety of colors, and retails at about ten cents per pound.

The process of the manufacture is a patent, and the material is prepared for use by mixing with it an equal measure of water, when it is applied to the surface with a brush. The process of manufacture was patented in 1875, and a company to make it was organized under the laws of the State of New York in 1879. 1,200 tons of the alabastine were made in 1881; the stucco used was procured of the Union Mills Company. It makes a firm and seemingly durable covering for a wall, without any apparent tendency to scale or crack off, and possesses no disagreeable odor or poisonous constituents.

Stucco, or calcined plaster, is largely used for making cornices, friezes, plasters, and other forms of interior decoration, but its use also in making the wall itself, substituting it for the lime ordinarily used in the mortar, is rapidly increasing. It makes a far smoother and more durable wall than one made with lime mortar, and undoubtedly the hygienic advantages of stucco walls over papered or draped walls, are important. Plastered walls permit of ventila-

tion; the air finds its way, without difficulty, through the porous plastering, but a papered wall is comparatively impervious to it. A room with thickly papered walls, without ventilation, retains the foul and excludes the fresh air; with the wall unpapered very much of the pernicious air escapes, and pure air is admitted. The objection to bare walls, which is sometimes felt, is measureably removed in the use of stucco; with it walls can be made in any degree ornamental, and the alabastine, if it proves to be what is claimed for it, must be of great assistance. Office of the company, Grand Rapids, Michigan.

M. B. CHURCH, *Manager*.

At the alabastine quarry on Lake Huron but little has been done for the past few years; financial trouble has nearly stopped all production at this point. The quarry and mill are now owned by Mr. B. F. Smith, and the affairs are now in shape for the prosecution of the plaster business at Alabaster on a basis corresponding with that of any of the companies at Grand Rapids.

Product for 1879.....	2,500 tons land plaster.
“ “ 1880.....	1,500 “ “ “
“ “ 1881.....	— “ “ “

COAL.





## COAL.

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The coal measures of Michigan are supposed to occupy an area comprising about one-fifth of the central portion of the lower peninsula. The seams of coal are interstratified with beds of shale, beds of coarse friable sandstone and clay. The entire formation has an estimated maximum thickness of about 300 feet. The upper rock of the series, in the southern part of the coal field, is the sandstone, a whitish, coarse grained rock, having a thickness, as shown where it is exposed in ledges, and where borings have been made through it, of from 20 to 50 feet. This sand rock is used as a building material, and answers very well for some purposes. The walls of the State Prison at Jackson are built of it, and rest upon it. From the center of the coal field to its northern limit the sand rock has been divided, and the drift rests upon the dark gray or blue shale; this slaty rock has generally little supporting capacity, and readily disintegrates on exposure to the action of the elements.

The extent of the coal field is embraced in a circle, with a radius of fifty miles, having its center southeast of the village of St. Louis, in Gratiot county, and its southern boundary passing a few miles south of the city of Jackson.

Over the greater portion of this wide field indications of coal have been found, and in many localities some incipient mining work has been done. But a limited amount of systematic exploring has been prosecuted, and the coal seams, which have been reached, vary from a few inches to a maximum of 4 feet in thickness.

The rock beds in lower Michigan have but few exposures; everywhere they are deeply buried by the overlying drift, so that actual boring is required to determine whatever of mineral value may lie beneath the surface in any particular locality. This operation involves considerable trouble and expenditure, and, unless for a specific object, is seldom resorted to. While the coal deposits probably exist over a wide field in Michigan, it by no means follows that the beds are continuous and that coal may be everywhere found in workable quantity. The basins in which the coal was originally laid down, unprotected by later deposits, have suffered from exposure to the forces of nature during the long geological periods that have intervened. Probably the greater portion of the coal originally deposited in this State during the epoch of the coal formation was subsequently worn away and destroyed by the moving glaciers of the drift period. The soft, yielding rock deposits of lower Michigan were eroded and swept away by the great rivers of ice that moved over them, to be again buried and hidden beneath the accumulated drift and debris furnished by these glacier masses, and by subsequent geological changes.

The coal and other formations which form the rock line in lower Michigan,

remain substantially horizontal as originally imbedded, but the valleys and chasms which here, as elsewhere, were doubtless formed by the eroding forces of nature, in this State are filled with the drift, so that the precipices and ledges, so frequent in other States, and which afford to the geologist the opportunity to study the strata and thus readily acquaint himself with the rock formations, are here excluded from his gaze.

With all the difficulties which have attended the geological investigation of the underlying rocks, enough has probably been done to render it certain that we have beneath our soil but a comparatively limited amount of coal. So far as is known there is but a single workable seam, and this has only a maximum thickness of 4 feet; more generally it is but from  $2\frac{1}{2}$  to 3 feet in thickness. Others may yet be found possessing an economic value, and the same seam may prove of greater thickness elsewhere than where now opened; but from present knowledge it may be stated that the stores of coal left by nature within the limits of this State for the future consumption of our people, are not enormously large. No doubt there is enough, when the proper time comes for demanding its use, to insure an adequate supply for the uses of the people of this State. The amount which has thus far been taken out is inconsiderable. The whole field remains practically untouched, and it is perhaps just as well that our limited supply of fuel below the surface should be reserved to meet the necessities of future generations, when we shall have exhausted the timber above it. Our State is so transcendently rich in other important minerals and in resources, that her people may well be reconciled to possess only a competence of coal. Coal was first discovered in place in this State in 1835, on section 1, in the township of Spring Arbor, in Jackson county, in excavating for the foundations for a mill. A shaft was sunk and some coal taken out, and the location became known as the Hayden mine. Subsequently the same company which operated here removed its operations to a point a mile further north, opening there what is known as the Woodville mine. This latter was started in 1857, and the shaft sunk to the depth of 27 feet, when some delay was occasioned, but in the following year the shaft was carried down to the bottom of the coal vein. From Mr. John Holcroft, M. E., who was also the company's agent at the time, I obtain the following statement of the section passed through in sinking the shaft.

	Feet.		Feet.
Drift.....	12	Bituminous coal.....	4
Sandstone.....	30	Fire clay.....	3
Shales.....	43		

From the bottom of the shaft drifts were extended into the coal seam, the average thickness of which proved to be about  $3\frac{1}{2}$  feet. To the east of the shaft, for a distance of 300 feet, the seam continued horizontal, when it rises in the next 190 feet, a height of 16 feet, and there ends, the coal vein having been, apparently, cut off by a deep erosion and the chasm afterwards filled with materials which now constitute sand rock. A gallery carried into this sand rock a distance of 100 feet failed to pass through it, but a boring put down from the surface 200 feet to the east intercepted the coal at the same horizon in which it was cut off to the west.

In the present underground work at the mine they are pushing forward to go through this intervening sandstone to open into the new ground to the east. West from the shaft the workings extend a distance of 500 yards, and to the north a distance of 330 yards; to the south, 240 yards. But over this area the coal has not been all taken out; a considerable portion of the deposit

yet remains to be excavated. The owners of the mine now, as from the beginning, are the Detroit and Jackson Coal Mining Company. This company operated the mine until 1872, taking out an annual product of about twenty thousand tons, which sold at an average of \$3.00 per ton for the best, and from \$1.00 to \$1.75 for the slack or screenings. The coal is bituminous, highly so, evolving a good deal of smoke when burned, and it is also thought to contain too much sulphur to make it suitable for foundry purposes and for blacksmiths' use. The coal from the Woodville Mine was employed in the manufacture of gas at the Jackson gas works, and also at those in Detroit, but Michigan coal is now little used for that purpose. The objection arises from the inconvenience of purifying the gas of the sulphur which it contains. The best purpose to which our coal seems to be adapted is in the production of steam—used under the boilers of locomotive and stationary engines. In heat producing qualities it is unsurpassed. From 1872 until 1881 the mine was shut down, when it was leased by Mr. R. H. Emerson & Co., operators of the Slope Mine, etc., and work at the mine has been resumed. The machinery, buildings, shaft, etc., have been repaired and put in good working order, an elevated tramway constructed, extending 200 feet east from the shaft, where the coal shutes have been placed and to which the railroad track has been extended. The mine has been unwatered with a Cornish pump, throwing about four hundred gallons per minute. The company own the mineral right to six hundred and eighty acres of land, to which the lessees of the company's rights, Mr. Emerson & Co., add three hundred acres adjoining, of which they hold the mining right.

The shaft is sunk from the surface of moderately elevated ground, which gives good surface drainage. It is vertical, well lined up, and separated into two parts, so that the platform in the one part goes up as the other platform descends. The wire ropes for hoisting run over and under a drum operated from the engine. The boilers and engine are solidly placed, and all the machinery is of a substantial character. They are now hoisting some coal, though the main work is still repairing the mine, putting in new timbers, tram roads, clearing away the fallen ground, where necessary, etc. Eight years of abandonment have naturally accumulated a good deal of necessity for repairs.

The Woodville Mine is about four miles west from the city, and enjoys the distinction of being one of the oldest, and for some years having been the most important of the mines opened in the vicinity of Jackson. Forty-two men are now employed in the mine.

About a third of a mile distant from the Woodville shaft, to the southeast, and close to the main track of the Michigan Central railway, is the Michigan Mine, owned and worked by the Michigan Coal Company. This company was incorporated in May, 1879, with a capital stock of \$30,000. Daniel McGarry, of Pennsylvania, President; Thomas A. Mason, Secretary, Jackson, Michigan; J. C. Eldred, Treasurer, Jackson. Eldred & Noyes, agents, Jackson, Michigan. The company secured the mineral right to five hundred acres of land, and hold in fee a small parcel in which the shaft is sunk.

The shaft is vertical, 80 feet in depth, and was opened soon after the formation of the company. The coal seam is from 3 feet to 4 feet in thickness, and has been worked a distance of eighty rods to the southwest of the shaft, and about the same distance to the north and to the east; in which work there was mined, in 1880, 20,021 net tons of coal, and in 1881, 23,987 net tons of coal.

The work for 1881 covers only about one-half of the year, as the mine in



December and January was filled with water, and from April until July a strike among the workmen in the mines caused all mining to be suspended. The water broke in through a weak place in the roof in such quantity as to flood the mine. This element of perplexity and hazard must always be inseparable with the prosecution of work in our coal mines, since it is impossible for the miner to know how much protection the overlying rock may afford him. At one point the sandstone may have considerable thickness, while at another point at no great distance it may have been entirely swept away. Two miles to the west, on the Michigan Central Railroad, a mine, which was opened and worked by Thomas Young some years ago, was abandoned for the reason of a want of support in the roof. The coal seam proved to be somewhat more than 3 feet in thickness, but the overlying rock is a soft shale with little tenacity, so that the whole dependence for support was in the timbers, rendering the liability of breakage and the cost of timbering too great.

The Michigan Mine is decidedly troublesome on account of water. They are using two 14-inch bucket lift pumps and three No. 10 Knowles pumps, and one No. 9 Pulsometer pump. They are going to try the efficacy of two 20-inch Cornish pumps. The machinery is good and of sufficient power to accomplish the hoisting with facility and dispatch. The lifts are worked with wire ropes running over a drum, and the cars discharge their loads directly into the shutes, which empty into the cars standing on the railroad track. As but little coal is held in store the amount hoisted from the mine per day depends upon the fact of having cars. When there are no cars to ship in, the coal is held in the mine until cars arrive at the shute; the accumulations are then hoisted. If the market is dull, or there is too long a delay, the miners are obliged to knock off from work until the glut in the mine is removed. Thus it is not uncommon for the mine to shut down for a day, or for a half day even, the pumps in the meantime being kept in motion, and the work of repairing tracks, roof, setting timbers, etc., being carried forward. The "flats," used for shipping coal on the railroad, hold from ten to fourteen tons. The Michigan company have now on their pay-roll the names of a hundred and sixty men.

The section of rock passed through in the shaft of the Michigan Mine corresponds very nearly to that of the Woodville shaft,—drift, sandstone, shale, coal. Underneath the coal, in these mines, is a bed of 3 feet of shale like that which is in contact with it above. The coal simply divides the shale. Nodules of kidney ore are found in the shale in considerable quantity. Interstratified with the coal, in all the mines, are thin belts of iron pyrites, which is easily separated from the coal. The coal has never been extensively coked for practical use.

Borings which have been made below the coal bed, show it to be underlaid, in some places, with sandstone, and in others by shales and fire clay. It was formerly thought that the sandstone was invariably the underlying rock, and that it was fruitless to search for coal below it; but further experience shows that there is no regularity in this respect. The sand rock, which is found in one point, is in another replaced by shales. And it is said that a 3-foot seam of good coal has been found after passing through 20 feet of what was thought to be the underlying Parma sandstone. It is possible, however, as there is little regularity in the occurrence of the rocks, which compose the coal formation, that the sandstone passed through was that which overlies instead of that which is found beneath the coal.



## THE SLOPE MINE.

The largest of all the coal mines now being worked in the State is the Slope Mine, situated within the corporate limits of the city of Jackson. The name is derived from the fact of the shaft being inclined instead of vertical.

The Slope is adjacent to the old Porter Mine, which extends south of it—almost constitutes a northerly continuation of it. The two mines are only separated by a bar of ground, which is left for safety, as the Porter Mine has been abandoned and is now filled with water.

The inclined shaft has a direction of north  $45^{\circ}$  east, and a run of 300 feet, reaching a point 100 feet below the surface. In descending, it passes over the northerly workings of the Porter Mine. The Porter shaft is in lower ground than the Slope, but the sequence of rocks passed through in the two shafts is the same, the coal being reached in the same horizon. In the Slope shaft is found a greater amount of drift and sandstone. The Porter shaft begins in sand rock, with no overlying drift, and passes through 26 feet of it; then 17 feet of shale, when the coal is reached, a bed 4 feet thick. The shaft was carried down 30 feet further through alternating shales and sand rock.

The Slope shaft, after reaching the bottom, continues in a horizontal gallery in the same bearing a distance of 600 feet, where it separates, and two galleries parallel with each other extend 300 feet further, meeting with a fault, erosion, or dike, which cuts off the coal. The coal seam is generally 4 feet thick, and averages fully  $3\frac{1}{2}$  feet. The sand rock, which comes in 900 feet from the shaft and cuts off the coal, extends transversely 300 feet to the southeast, diminishing gradually until it disappears and the coal again continues regularly. But in the opposite direction, transverse to the gallery, the intercepting rock soon bends around to the west and continues in a west course for a distance of two hundred and forty yards, cutting off the coal seam completely until it runs out. West of this intercepting sand rock the mines have extended to the north of it 1,000 feet, and the Slope gallery has also been recently driven through it, so that the coal bed lying beyond this wall is now opened for mining; cross drifts will be extended through it and the coal seam chambered out.

The wall of barren ground is 50 feet wide, except at the extreme end, where it runs out. The available ground beyond it is about equal to what has been already worked out.

The bed is not quite level, but has an undulating form, in one part making a heavy roll so that the coal rises 15 feet above the bottom of the tunnel, which is driven horizontally 100 feet through the underlying sand rock; further on the coal seam comes down to its former level. The ground from the shaft north a hundred and thirty yards to the sand rock wall, and for five hundred yards east and west, is mined out; very little coal is left. The "rooms" come closely together; the partitions are very narrow, but by a free use of timbers an apparent safety is preserved. These timbers are from 3 feet to 6 feet in length, and about 6 inches in diameter. The longer ones are used along the main galleries, in which rails are laid and the mule trains are run; cross timbers and planking against the roof are also employed for its support. To the south the work is limited to the safety line preserved to prevent breaking through into the old Porter Mine. In all the Jackson mines water comes in pretty freely, and to get rid of it is a matter of some expense and trouble. A good deal of ditching is necessitated to run the water into sumps, and there are three No. 10 Knowles pumps kept running in the Slope Mine to pump

it to the surface, where the descent of the ground rapidly carries it away to the river. One of the pumps draws the water from a distance of a hundred and twenty-five yards.

But little blasting is necessary. The coal is mined by digging out the bottom of the seam as far in as practicable, and then by driving in wedges at the top, between the seam and the roof, breaking down the coal as far in as it was undermined. The miners work on contract, receiving thirty cents per car load, equal to about ninety cents per ton. They furnish their own tools and lights, etc., and push the cars to the main tracks, where it can be drawn out to the shaft by the mules. Eight mules are used—kept stabled in the mine—to do the hauling. The tracks are mostly laid with light T rail. The shaft is furnished with a double track, over each of which runs an endless chain that at the top and bottom of the shaft passes around large grooved pulleys, which revolve horizontally. The upright iron shaft to which the upper pulley is attached is connected by bevels with the main shaft of the engine below, and is thrown into and out of gear at pleasure. While hoisting is being done, however, the chains are continuously running, up one track and down the other.

The loaded cars are drawn by the mules in the mine to the shaft, thence pushed under the moving chain, which drops into the iron slots projecting up from each end of the car it is taken up to the track. The up track is elevated at the top above the down track; this elevation is to give the cars a down grade for a run of 30 feet to come under a chain that draws them 150 feet further to the chute. This endless chain, extending to the chutes, runs around a grooved pulley attached to the same upright shaft that carries the chain down the slope. The return of the chain brings back the empty cars, and in the same way they are taken down the incline. Cars can be attached at any time and anywhere on the chain, and are continuously going up and down the slope and to and from the chutes. One man at the top attends to the transferring. The chutes are at the end of the long elevated covered track, which ends in a room the floor of which is covered with tracks running to the different chutes, three of which are for the railroad and the others for town trade. The railroad chutes hold about forty-five tons, and have rack bottoms for screening the coal as it is dumped in and slides down the rack. When working full force they take out about four hundred tons daily. The mine now employs one hundred and twenty-five men. The mine has quite a local town trade. Teams are constantly hauling coal from the mine into the city, but the bulk of the product goes to the railroad company to be used on the locomotives.

They have three grades, to wit: Lump, nut, and screenings or slack. The former sells at about \$3.00 to \$3.50; the nut for \$2.50 to \$3.00; the screenings for about \$1.00. The latter sells to stationary engines, etc., and by widening the bars in the grate so as to increase the draft and prevent caking it answers excellently well.

At present the coal trade is dull with these mines. By reason of the long strike last summer they were unable to meet the demand. The Michigan Central railroad made its contracts for Ohio coal, so that the railroad can now take only a portion of what it uses, from the mines, which is not all the mines are able to supply.

On February 26, 1881, the buildings were all burned, so that the shaft house, and all the buildings about it, are new. The mine was opened in 1879. During the nine years previous to that the same company had worked the Porter mine and had mined an average annual product of fifty thousand tons.

Since opening the Slope Mine in May, 1879, the amount of coal taken out is as follows:

1879-----	54,635 net tons.
1880-----	74,743 " "
1881-----	69,066 " "

The iron pyrites, which occurs in separate limited deposits in the coal seam, is sent to the chemical works, owned and run by the same company, where it is used in the manufacture of crude sulphuric acid. These works are but a short distance from the mine, and take about three tons of the sulphuret per day, using what is found in the Slope mine and purchasing what the other coal companies are able to furnish. These works turn out about one hundred tons of acid per month, and it is all sold to the Michigan carbon works, and used in the manufacture of the so-called superphosphate—agricultural fertilizer. The mine foreman is John Robinson, a coal miner of lifelong experience, and the company's business office is Jackson, Mich., R. H. Emerson & Co. Mr. R. H. Emerson, Jesse Hurd, and Wm. E. Hawkins have leased the Williamston coal interests in Ingham county and commenced in the fall of 1881 to re-open an old mine, which was worked to a limited extent there some years ago. On the banks of the Cedar River, near Williamston, a coal seam comes to the surface enclosed in an exposed bed of shale. Not far from this exposure two shafts have been sunk—one vertical and one inclined. There are two coal seams, the upper one lying immediately under the drift, with no intervening rock. At the shaft the upper coal seam is 20 inches thick, underlaid with 1½ feet of fire clay, 3 feet of black shales, white, soft fire clay 3 feet, slate 2½ feet, bituminous coal 3½ feet, fire clay 4 feet. A large territory has been explored in this neighborhood by means of borings, and the results show an underlay of two coal seams, 15 to 20 feet apart, over the entire region tested; the upper one is too thin to be of value, and the lower seam has an average thickness of 3 feet, but has, unfortunately, a poor roof. The coal is of good quality, with the usual seams of pyrites, readily separated from the coal. Several attempts have heretofore been made to work it, which thus far have proved failures. Perhaps Messrs. Emerson & Co., bringing greater capital and experience to the undertaking, will make the work successful. The company has put in adequate machinery and otherwise equipped the mine.

About one mile northwest of the Slope Mine is the Eureka Mine. This mine is entered by a vertical shaft 53 feet deep, which is sunk in a rise of ground 200 feet west from the main line of the Jackson & Lansing railroad. The company was organized in June, 1879, with a capital stock of \$25,000. President, John Bullock; Henry Bullock, Secretary; M. S. Hitchcock, Treasurer and Superintendent; office, Jackson, Mich. The mine is just outside the city limits, and the company hold the mineral right to one hundred and five acres of land. The coal seam is 3 feet to 4 feet thick, and has been worked out over an area of twenty-five to thirty acres. But little coal was taken out the first year, but in 1880 30,000 net tons were raised, and in 1881 37,477 net tons were raised.

The mining right is based on a royalty of fifteen cents per ton for screened coal. Ten to fifteen cents per ton is the usual royalty paid by all the coal companies. Considerable trouble is experienced on account of water. Four No. 9 Knowles and one No. 9 Dickson pumps are used; the latter draws the water 400 feet. The company pay the miners thirty-seven and a half cents per ton for mining, which includes pushing the cars to the shaft and taking



back the empty ones. Sixty miners are employed and about fifteen surface men. During the strike, from April till July, 1881, the mine was idle, so that the company lost its trade and has not yet fully recovered it.

The machinery comprises two large boilers in use, and one idle, and a hoisting engine. The platforms carrying the cars, etc., are raised and lowered in the shaft with wire ropes running over and under a drum, worked by the engine. The railroad track enters the shaft house so that the chutes are close to the mouth of the shaft. The coal is hoisted and loaded into the cars with rapidity. Nearly the entire product is sold to the railroad company.

The Slope, Eureka, Michigan and Woodville are the only coal mines now working in Jackson county, and their aggregate output as heretofore given is,

1880.	Net tons.	1881.	Net tons.
Slope.....	74,743	Slope.....	69,066
Eureka.....	30,000	Eureka.....	37,477
Woodville.....		Woodville.....	
Michigan.....	20,021	Michigan.....	23,987
Total.....	124,764	Total.....	130,530

### CORUNNA.

The only other coal mines in the State that are now in operation, besides those already mentioned, are near the city of Corunna, in Shiawassee county. Here there have been five mines opened, three of which have for a long time been idle.

Coal was first taken out here by Mr. Alexander McArthur from an outcrop in the bank of a stream on the W.  $\frac{1}{2}$  N. E.  $\frac{1}{4}$  of Sec. 22, T. 7, R. 3, Caledonia township. A son of McArthur related that the discovery of the coal was made by a party of Indians, who had built a fire upon the coal seam where it outcrops, and who, upon returning to the place a few days afterwards were astounded to have their eyes and olfactories greeted with a dense, sulphurous smoke emanating from the earth. Considerably excited, and frightened withal, they hastened to the village to relate what they had seen, declaring in their Indian tongue that they had found a veritable hell. Some white men going to the spot solved the mystery.

McArthur mined out coal more or less for upwards of twenty years, employing from twelve to thirty men. It was sold mainly to blacksmiths. The vein averaged about two feet in thickness. About half a mile to the east of the McArthur mine was the Frazier mine, which started later than the former and thereafter was worked contemporaneously with it.

This mine was upon lands owned by Mr. Alexander Frazier, of Detroit, and was operated by Mr. Stanton as agent for Frazier until about 1870. No money was made, a good deal of indebtedness was incurred, and the undertaking was abandoned.

In 1870 a company was organized at Youngstown, Ohio, for the purpose of mining coal at Corunna, a large amount of land was leased, and a mine opened on the S. W.  $\frac{1}{2}$  Sec. 23, T. 4, R. 3. Under the direction of Mr. Gilbert, the company's agent, twenty houses were built for the use of the employés, and other improvements made. Gilbert seems to have been well qualified for his duties, but after four years of service he resigned and returned to Ohio, and was succeeded by Peter Rush as agent, who proved not so fortunate in the management of the company's affairs. Through neglect in preserving the proper repairs the shaft fell in, stopping the pumps, and the mine becoming filled



with water work was suspended. This was in 1875. The location of this mine is about two miles northeast of Corunna, upon the east side of the Shiawassee River, in the bottom lands through which the river makes its bed.

The shaft was inclined and extended vertically downward about seventy or eighty feet, passing through

	Feet.		Feet.
Drift.....	10	Fire clay.....	4
Dark shale.....	30	Black slaty shale.....	8
Sandstone.....	4	Coal.....	3
Slaty shales.....	6	Fire clay.....	4
Coal seam.....	1		

The underground workings extended 600 feet east and west, and 1,000 feet north and south. The work to the east was limited by a "sand bank," a deposit of sand rock, having a northwest and southeast direction, which cuts off the coal in a very similar manner as occurs in the Slope Mine at Jackson. The mine was not unwatered, and for two years no work was done; but in 1878 the company sent Mr. Todd Kincaid to examine the property and to recommence mining.

It was decided to sink a shaft and to open a new mine adjacent to the old one, and west of it a distance of 50 feet. The shaft is vertical, about 70 feet in depth, from the bottom of which the workings run 1,600 feet to the north and the same distance south and west, while to the east the old mine limits the extension in that direction, as does also further north, the "sand bar" found east of the old mine, by bending westerly as it goes north. The coal seam has an average thickness of about 2½ feet, becoming 4 feet in places. A good deal of trouble is experienced from the large amount of water to be pumped out, requiring ten tons of coal every twenty-four hours to run the pumps. The roof is a black shale, smooth and tolerably compact in places; in others it is loose and insecure; it is also of variable thickness. Above the shale is the sand rock, from 4 feet to 20 feet thick. The drifts are laid with wooden rails for the cars, which are hauled to and from the shaft by mules. Under the coal is a bed of 4 to 6 feet of fire clay, perhaps adapted to the manufacture of tile, pottery, and brick; a few barrels of it have recently been sent to Akron, Ohio, to be tested for this purpose. A seam of iron pyrites runs through the coal similarly as at Jackson, but it is claimed that the coal here contains less of the sulphur than the Jackson coal does; in appearance it is the same, and is mainly sold to the Detroit & Milwaukee Railroad Company, to supply the locomotives on the west end of this road. It is also used, to a limited extent, by blacksmiths and in foundries. The machinery consists of hoisting engine, working a drum with wire ropes, which extend down the shaft, and three large boilers for supplying the steam to the engine and to the pumps. A track from the branch of the Detroit & Milwaukee Railroad comes into the shaft house so that the skips have but a few feet run to the chutes that discharge into the cars.

During the three years that it has been worked, the mine has yielded about twenty thousand tons of coal, an average of nearly seven thousand tons per year; but it has afforded no profit. About \$140,000 have been expended and not half the amount returned from the sales of coal. It costs about \$1.30 per ton to mine the coal in addition to the royalty, which is ten to fifteen cents per ton. Besides, they have had to work up a market; the quality of the coal has been held at a low estimate, and the railroad company had but little faith in the continuance of the supply. It was not felt that the coal mining industry was permanently established, but only prosecuted as a trial or venture that

was liable at any time to be abandoned. Realizing the situation the company has prosecuted a series of borings with a view to thoroughly explore the surrounding country, and in future to conduct their mining operations with a better understanding of the situation. Upwards of sixty holes have been drilled and a record of them kept. Some of the old leases were relinquished and new ones made. The company have now about twelve hundred acres of contiguous lands under lease which they have sufficiently proved to establish the fact that this territory is underlaid with a coal seam 3 feet to 4 feet thick, with a reasonably good roof.

It became plain that the present mine must be abandoned; it was too costly to work, and it was thus decided to open a new one. Accordingly the location was carefully made and the work of sinking another shaft was begun in June, 1881. The site for this new mine is the S. W.  $\frac{1}{4}$  of the N. E.  $\frac{1}{4}$  of Sec. 23, T. 4, R. 3.

The shaft is 67 feet in depth, 8x16 in size, well lined up and is divided into two equal divisions. A good deal of difficulty was met with in sinking it, owing to the quick sand. From the bottom of the shaft a main drift has thus far been opened, east and west each way from the shaft 200 feet; to the east the roof is very smooth, hard, and firm, but to the west the ground gives evidence of disturbance; the roof is broken and rough, and cross timbers are required to support it. A parallel drift runs to the pumping shaft and thus secures air drainage—the air coming down the main shaft passes up the drift and is thence drawn off into the side drift, down which it flows and up and out of the pump shaft. At the foot of this shaft is the sump into which all the water is conducted, and thence forced up to the surface by a heavy Blake's pump.

The plan upon which the mine will be worked is to run off lateral drifts each 300 feet along the main drift, and at every 30 feet to extend out short sub-laterals at the ends of which the "rooms" will be made from which the coal is mined out.

In the main drifts the bottom is taken out below the coal sufficiently to give enough depth for the mules to travel, but in the lateral drifts, unless for drainage or for some especial purpose, the depth is only the thickness of the coal seam, and in traversing about one has to keep in a stooping posture to an extent that to the unaccustomed soon becomes excessively tiresome. Old coal miners, however, do not mind it, but work all day in these places without experiencing any extraordinary inconvenience.

The coal in the new mine of the Corunna Company is in places 4 $\frac{1}{2}$  feet thick, and is nowhere under 3 feet, and it is certain that over an area of several hundred acres in this vicinity it preserves a pretty uniform thickness. The coal bed rolls somewhat, the upward curves being several feet above the depressions. The same is true of the formation in all the coal mines in the State; but the bottoms of the drifts must be kept uniform for drainage and for the tramways.

This new Corunna Mine seems likely to prove a success. The agent, Mr. Kincaid, declares that if he were not certain of raising and disposing of at least two thousand tons per month they would not have opened the mine. When this mine is fully opened and working, it is intended to abandon the old mine. The yield of the old mine in the last month of 1881 was eight hundred tons. The company employ about one hundred men. The general office is at Youngstown, Ohio. George Todd, President; Todd Kincaid, Secretary and Treasurer, Corunna, Michigan.

OWOSSO.

No mining is now being done at Owosso, three miles west from Corunna; but a shaft was formerly sunk there within the city limits, near the margin of the river. The shaft was 40 feet in depth. In this distance two seams of coal were intercepted, each one about  $1\frac{1}{4}$  feet in thickness. The coal is of a sufficiently good quality, but the seams are too thin to insure profitable working. Several attempts to work them have been made, but were soon after abandoned as unremunerative undertakings.

Near the depot, at Owosso, of the Detroit & Milwaukee Railroad, a hole was bored to the depth of 307 feet, but only a single seam of coal was found of 6 inches in thickness. The record in full is as follows:

	Feet.		Feet.
Drift.....!	40	White sandstone.....	16
Fire clay.....	5	Shales.....	22
Blue shale.....	20	Blue sand rock and shale.....	46
White shale (arenaceous).....	8	White sand rock.....	11
Blue shale (partly arenaceous).....	107	Dark shale.....	5
Coal..... 6 inches.		Sand rock.....	27

The boring terminated in shale.

FLUSHING.

A small amount of coal has from time to time been mined at Flushing, in Genesee County. There are several outcrops of this mineral in the vicinity; but mining work has never been systematically prosecuted. Perhaps a lack of railroad facility has retarded exploration; but coal seams, which are  $2\frac{1}{2}$  feet thick at the outcrop can, it is said, soon thin out. Occasionally a few miners have gotten out a small amount of coal and sold it to local buyers.

A boring recently begun passed through a seam of coal 3 feet in thickness at a depth of 14 feet below the surface.





# SANDSTONE AND CLAY.



## SANDSTONE AND CLAY.

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The sandstone belonging to the coal measures furnishes at various points some important quarries of building stone. Notably at Flushing, the sandstone is of a micaceous texture, of a greenish color, and in portions occurs in beds, so that it can be quarried in blocks of a suitable size, and made into fine cut stone. This stone does not probably possess sufficient resistance to crushing force to make it adapted to the construction of large buildings, neither does its texture seem to be firm enough to enable it to withstand, for a long period, the disintegrating force of the extremes of our climate. It is claimed by those who have been familiar with these quarries for a considerable time, that durable building stone can be obtained here in any amount.

The sandstone here has a thickness of about 25 feet, some of which is thinly laminated, and other portions are in regular beds, of a thickness varying from  $1\frac{1}{2}$  feet to 2 feet.

Numerous sandstone quarries have been opened in Jackson county, chiefly in the townships of Springport, Sandstone, and Parma. It is a light-colored rock and has a glistening appearance in the sun, due to the clear quartz crystals which it contains. In some of these quarries the rock is in thick beds and of firm texture, and is said to be a first-class building stone, strong and durable. It is a white—sometimes yellowish colored—quartzite, or glittering sandstone, containing traces of vegetation. The walls of the Times building, in Chicago, are made of this stone, quarried and shipped from Sandstone, Jackson county.

At Napoleon, in this county, is an extensive quarry of gray sandstone. The section is nearly 80 feet, and the quarry covers upwards of a hundred acres. The beds are of a different thickness and furnish both flagging and building stone of an excellent quality.

Some of the beds have a fineness and sharpness of grit to answer for grindstones, and the stone has been used for this purpose to a considerable extent.

### CLAY.

Another important industry has grown up in Jackson, known as the Jackson Fire Clay Company. This company has extensive works in the vicinity of the Slope Mine, where they manufacture fire brick and sewer pipe.

The clay is brought from near the Spring Arbor coal mines, and from five miles north of Jackson, from what is known as Batchelder's Place. The clay is found here in unlimited quantity and proves to be excellent for the manufacture of sewer pipe and for fire brick.





COPPER.



## COPPER MINES—ONTONAGON DISTRICT.

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Ontonagon is one of the largest counties in Michigan, and while one of the most isolated, is really, in material resources, one of the richest in the State. Its whole territory is as yet almost an unbroken wilderness covered with forests of pine and hard wood that must ultimately be of great value. The soil, everywhere in the county, is a rich, productive loam, susceptible of cultivation and will yield to the farmers who in the future are sure to till it, abundant harvests of hay, oats, wheat, barley, potatoes, and even corn. Messrs. Stannard and Hoyt, of Rockland, have recently, on application, sent to the Agricultural college specimens of their crop of 1881, showing as handsome, sound Yankee corn as can be produced anywhere.

Perhaps it is as well for the county, in the long run, that its resources have thus been, from necessity, held in reserve; its great areas of pine, birdseye, birch, lynn, poplar, etc., will be all the more valuable for the delay; the time must inevitably arrive when it will all be demanded. It is folly, in this late day, to regard our timber as only an incumbrance—something to be wasted—and got rid of as speedily as possible; thoughtful men have witnessed the rapid disappearance of our forests with too much concern not to realize that this vast wilderness, which covers the soil of Ontonagon County, is among its most valuable resources—a possession in which the business of the whole country claims an interest.

In a few years more the isolation of Ontonagon County will be a matter of the past; already its primitive solitudes have been awakened by the scream of the locomotive; the first twenty miles of the railroad, which is the occasion of so much controversy, have been constructed, and when it reaches the State line it will be met by the Milwaukee & Northern, of which line it will form a part. A line has been surveyed from Wisconsin northwesterly to Lake Agogebic and thence to Union Bay. The Menominee branch of the Chicago & Northwestern will be extended to the Agogebic iron range; and the Marquette, Houghton & Ontonagon Company, aroused to the necessity of effort to preserve its franchises, has extended the survey of its line westerly and begun the work of clearing out the line thus located, so that in all probability Ontonagon County will soon be in railroad communication with the rest of the country.

The chief consideration entertained toward Ontonagon County, heretofore, has been due to its mines, which of late have been possessed of but little comparative importance; but

### ITS IRON DEPOSITS—

Agogebic iron range—are now attracting much attention, and the explorations,

which have been prosecuted during the past year, have developed the existence of ore in sufficient quantity and purity to insure the opening of iron mines and the prosecution of the iron mining industry, in this range, on a scale of considerable magnitude, while its copper interests have recently received an impetus through the revival of work at the

#### NATIONAL.

Nearly all Lake Superior mining men who are acquainted with its history have faith still in the National, and fully believe that when again opened and worked, with the improved appliances and methods that now prevail in mining, this abandoned mine has a future history that shall rival its remarkable past.

The location of this mine is in Sec. 16, T. 50, R. 39, and mining work was inaugurated here in 1848, and from that time, for a period of twenty-three years, until the company shut down in 1871, its record was one of abundant success. Notwithstanding the long and expensive litigation which it carried on with the Minesota, in order to secure its title to the land, the company was enabled to produce upwards of five thousand tons of refined copper, affording an aggregate income of \$2,295,231.50 from which the stockholders had received, in return for their original expenditure of only \$110,250, the sum of \$319,255—nearly three hundred per cent., or \$3 returned for every dollar expended. This very favorable showing was accomplished with the comparatively crude methods at that time in vogue. Only what seemed to be certainly productive ground was pushed into. No risks were taken; the stamping facilities were so meagre as to occasion, when compared to those of the present day, almost a total absence of production from that source.

The mine was opened to a length of 2,820 feet, and to an extreme depth of 950 feet. There were ten levels and eight shafts, and in all of the levels very much of the ground was left untouched. But the mine failed to afford its accustomed dividends; the stockholders began to be apprehensive of assessments, and without waiting to push on or to push down; without accepting the uncertainties of mining and endeavoring to determine if there might not be still further hidden treasures to reward the efforts of the explorer, they somewhat precipitately, in 1871, shut down.

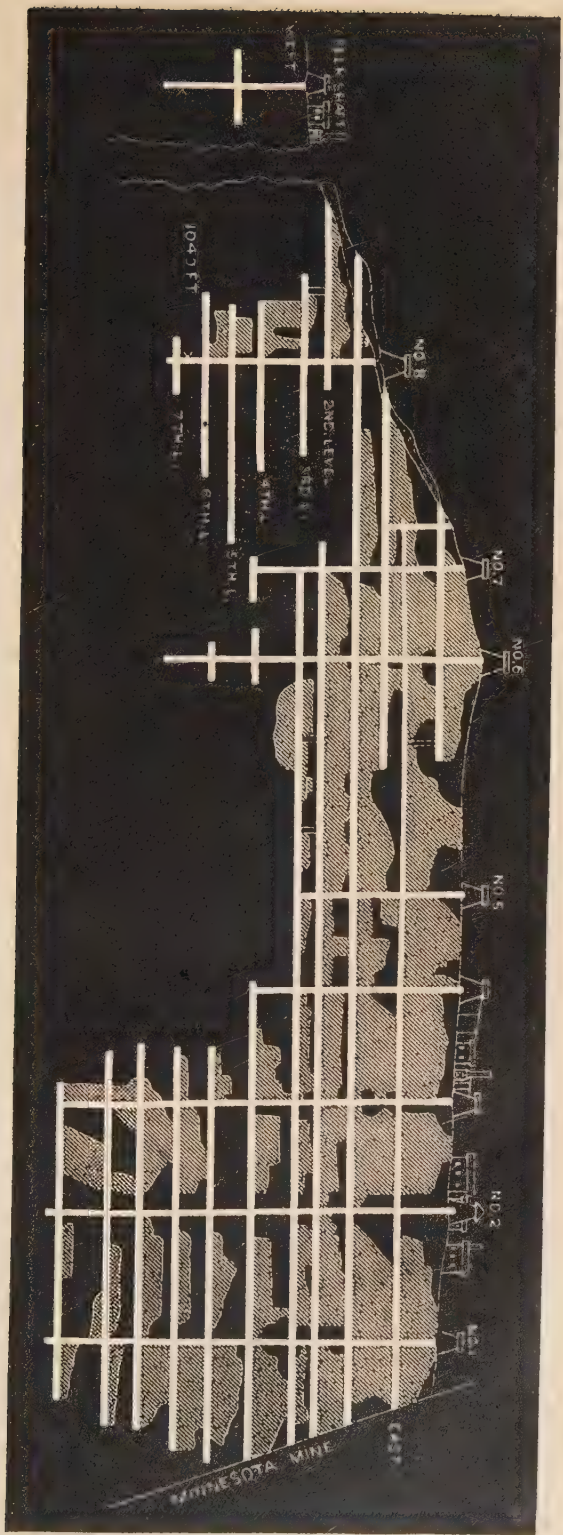
Thenceforward, for several years, the mine was turned over to the destructive working of tributers, and from their share in this work of pillage the stockholders derived an income from the mine in dividends of \$40,000. But the floors were torn up, the pillars were stoped away, the stulls and supports knocked out, and waste rock and timbers were dumped down into the shafts until they became filled from the bottom up with the rejected materials. The ground was worked away from under the shaft houses and machinery so that the engines and boilers had nearly disappeared beneath the surface. The houses and other buildings, of which there are a goodly number, and which were originally substantial and well made, were left for ten years with little or no repairs. And thus the National, once the pride of Ontonagon County and the boast of her mining men, was fast taking on the appearance of abandonment and ruin.

In 1878 the control of the affairs passed into the hands of the present owners, who removed the office of the company to Boston, and resolved to unwater and to work the mine. Capt. E. W. Parnell, a former mining captain at the National, was chosen to undertake the charge of this work, and in May, 1880, left the Phoenix and entered upon the discharge of his new duties



LONGITUDINAL SECTION OF THE NATIONAL MINE, JAN., 1881.

Scale, 300 ft. to one inch.





Everything was so greatly out of repair and so in need of immediate attention that it was difficult to decide where first to begin. But the captain began with a will and the results of his work are agreeably apparent everywhere about the mine. The buildings have been repaired, furnished with foundations where such were wanting, and put in shape to be occupied. A substantial shaft-house has been built. The great hoisting engine has been unearthed and placed upon a solid stone foundation, where it stands ready to work. A small engine for hoisting was placed in the south end of the shaft-house, and the wire hoisting rope carried up to the top of the building and down the shaft to haul up and let down the skip loads of waste rock and timbers met with in clearing the shaft and the drifts. The pumping engine, which is doing the work of raising the water from the mine, was also placed on a solid stone foundation. A stone boiler house was built and three locomotive boilers resurrected from the earth, into which they were fast disappearing, and placed therein. The stone change-house has been repaired and put in excellent condition for the accommodation of a large number of men.

In January, 1881, the work of pumping began. Freeing the National of water meant draining a reservoir 5,580 feet in length, including the Minesota and the Rockland Mines, and 500 feet in depth, from which the water had to be raised a further height above the adit of 250 feet, and then, below the connection with the Minesota, a further depth of 300 feet, and 2,850 feet in length. But the raising of the water is the easiest part of it. Clearing out the rubbish, supporting the ground, enlarging and relining the shaft, constitute by far the most difficult part of the undertaking, and this is being done in a thorough and systematic manner. No. 2 shaft, leading down into the east part of the mine, was the one chosen. The shafts were originally nearer together than is now thought necessary, and No. 2 shaft will suffice for working the whole of the east end of the mine as heretofore opened. They are already down 700 feet, and 50 feet more will relieve them from further unwatering the Minesota; and about 300 feet will bring them to the bottom of the mine. The water is raised with a Cornish plunger pump, pipe  $12\frac{1}{2}$  inches inside diameter. The lifts are 200 feet apart; thus far there are three, and they are going down with the fourth. No mining has been done, as the shaft is constantly used in hoisting the debris. Eighteen men are employed in this underground clearing away work. They work in three shifts, eight hours each, six men in a shift. Between No. 3 and No. 6 shafts the mine was never worked below the fourth level.

Recently Capt. Parnell has begun the work of sinking a shaft in the north lode, lying 140 feet north of the main lode. This new shaft is distant 250 feet from No. 2. The results met with are very encouraging. The shaft is down 100 feet and considerable mass copper has been taken out, amounting thus far to several tons. The lode is a conglomerate made up of a mixture of a variety of minerals cemented together by a silicious matrix; it was formerly slightly explored by the old company in 1862-3, by a cross-cut from the second level below the adit, and some drifting done in it, but the company, believing it to be a stamp lode, being only in search of mass copper, and having very limited stamping facilities, abandoned the work of further exploration. Capt. Parnell intends, as soon as he has sunk to the requisite depth, to drift in the lode to intersect this old opening, and thus connect the two mines. If the lode is found to yield stamp rock, as is anticipated, a mill for working it up will become necessary, and the question of the location of such a mill become one of the problems to be solved. The little stream that winds

between the bluffs on which the old stamp mill was placed, affords but a small amount of water, and certainly cannot be esteemed of much value for washing purposes, but possibly a single head of Ball's stamps, with improved washers, might be erected on the old site and answer for a limited amount of work, and then be removed to some better location when further development had enabled the company to determine the matter of the necessity of a larger mill and upon its location. It is but a short distance to the Ontonagon River, which affords water enough for stamping, etc., if any plan can be devised by which the water can be rendered available for this purpose without interfering with other interests connected with the use of the stream.

The railroad is now completed to Ontonagon village and its track runs three miles in the National property; a stamp mill could thus be built on Lake Superior and the rock transported thence twelve miles. But if the Marquette, Houghton & Ontonagon Railroad is built through from L'Anse, it is possible that it may be thought to be more advantageous to build stamp mills east of the mines, in the direction of L'Anse, than to the west, since it is eastward that all the product is destined to go, and there would be a saving in transportation. But the question of a stamp mill does not, at the National, demand an immediate solution. To clear the mine and get ready for mining will occupy the attention of the management for yet six months to come, after which they will probably be ready to prosecute mining work. The work of clearing the mine of water and refuse timbers and rock, and of making the unavoidable repairs underground, has proved to be a more difficult undertaking than was at first anticipated, and will require a longer period of time to consummate than was originally believed to be necessary; but the work is being thoroughly performed, and it would seem also that all due economy was being exercised. The estimated cost of clearing the mine and of making necessary repairs, etc., is \$75,000.

The company's estate comprises 1,889 acres of land, stretching in irregular shape, a mile in width, across half of the mineral range. The Ontonagon & Brule River Railroad Company has three miles of its line built in the National property.

There are a number of well determined metallic lodes crossing the National lands that have been proved by previous work to be worthy of further exploration.

The officers are J. C. Watson, President, Boston, Mass.; D. L. Demmon, Secretary and Treasurer, Boston, Mass.; Wm. E. Parnell, Superintendent, Rockland, Mich. No. of shares, 40,000, par value, \$25.00 each.

#### THE MINESOTA MINE

Adjoins the National, and is the oldest and most celebrated mine in the Ontonagon district. The mine is situated on Section 15, T. 50, R. 39, and its underground drifts are connected with those of the National to the depth of about 700 feet. The mine is 2,820 feet in length, and about 1,200 feet in extreme depth. Its direction conforms to the rock formation, being about N. 65° E. The formation dips about 44° northwesterly, but the lode has a varying dip of 52° to 64°. The surface at No. 4 shaft, is 650 feet above the Ontonagon River, which is one and a half miles distant to the west of the mine. The lode is irregular, having a varying width of from 2 feet to 8 feet. The gangue is quartz, calcite and epidote, and the mine has afforded many very beautiful specimens of crystallized minerals, including copper.

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The first shipment of copper, consisting of six and one-half tons, was made from this mine in 1848, the same year that the company was first organized under a special charter from the State of Michigan. In 1855 a reorganization was made under the general mining laws of Michigan, and the capital stock was fixed at \$1,000,000, divided into 20,000 shares.

The first dividend, \$30,000, was paid in 1852, the fifth year of working. The assessments amounted to \$60,000, and up to the period of paying dividends \$400,000 had been expended, \$320,000 of which sum was obtained from the sale of copper.

The total dividends paid amount to \$1,920,000. The maximum product was obtained in 1860. Nearly 70% of the product of the mine, up to 1861, was in mass copper, and only about 6% in stamp work; but as the yield of masses fell off more attention was given to the stamp rock. But the stamp mill was a crude affair, as compared to those now in use, and the water supply was very inadequate, so that when the mine failed to yield masses to the extent necessary to meet the current expenses, the company resolved to shut down, and accordingly the pumps were stopped in 1870, and from that period the mine has been allowed to remain filled with water. For a few years prior to that date, and subsequently, the mine has been mostly worked by tributers, and its condition is undoubtedly similar to that of the National, heretofore described.

The work of the company during the past two years has been confined to exploration with the diamond drill along the south bluff. Holes are sunk to a distance of from 100 to 300 feet in length, at an average cost of \$1.55 per foot. The results have not led to the commencement of active mining in this bluff. There is a rumor that the company contemplates completing the unwatering of the old mine and exploring it to greater depth, etc.

At the last annual meeting a new board of directors was elected, consisting of the following named gentlemen: Geo. D. Pond, E. M. Jerome, J. J. Dwight, Thos. F. Neasmith, J. Olis Wetherbee, Benj. F. Pond, and Thos. D. James. Geo. D. Pond was elected President, and J. Geo. Rippelon, Secretary. Office in New York, N. Y.

It is inferred that the change of management implies increased activity, and the Ontonagon people are greatly in hopes that such may prove to be the case. Many good mining men are of the opinion that with the present improved appliances and methods of mining favorable results would follow the resumption of work in the old mine.

The results of the operations for the past year, the company's financial condition, etc., are set forth in the following annual report, dated March 15, 1882:

We have to report that work during the past year has been chiefly devoted to explorations by means of the Diamond drill, and which so far have given no results of a character warranting the opening of any new mine. We have expended for this purpose \$3,730.99, and propose to continue another year to work the drill in such parts of our property as have not already been thoroughly investigated, when it will be necessary to determine definitely, in case of no greater success than has hitherto attended our efforts, whether to cease further expenses in this direction.

The product of copper by the aid of tributers has diminished, to quite a nominal quantity, consequent on the rate of wages having increased in the region to an extent that makes working a tribute undesirable to the men hitherto engaged in this way, who can generally do much better now through regular employment. The ground, however, is by no means exhausted, and at

some future time it may be practicable to get a large number of men willing to go to work, when our resources may be increased. The accounts for the year are hereto annexed.

H. S. Henry, President; Edmund Hendricks, G. P. Saterlee, and Charles M. Stead, Directors.

#### PRODUCT AND VALUE OF MINERAL.

The product of the mine, in mineral, for the year 1881, was 35,030 lbs., yielding ingots 24,227 lbs., and in cash.....	\$4,297 75
The product of mineral for December, 1881, is 3,686 lbs.; bought of the tributors for.....	290 46
	<u>\$4,588 21</u>

#### COST OF PRODUCTION.

Balance—mineral at mine December 31, 1880.....	\$242 49
Wages—amounts paid tributors, \$2,773.58; surface labor, \$787.62; salaries at mine, \$1,500; powder, wood, etc., \$155.18.....	5,216 28
Transportation, \$217.40; insurance, \$9.96.....	227 36
Smelting, \$313.77; taxes, \$1,158.32.....	1,472 09
Salaries at New York.....	1,600 00
Office and general expenses.....	807 45
	<u>\$9,565 67</u>
Less profit on interest, rents, farm, merchandise, etc.....	1,355 17
	<u>\$8,210 50</u>
Expenses over value of product.....	3,622 29
	<u>\$4,588 21</u>

(The amount expended in working the Diamond drill was \$3,730.99.)

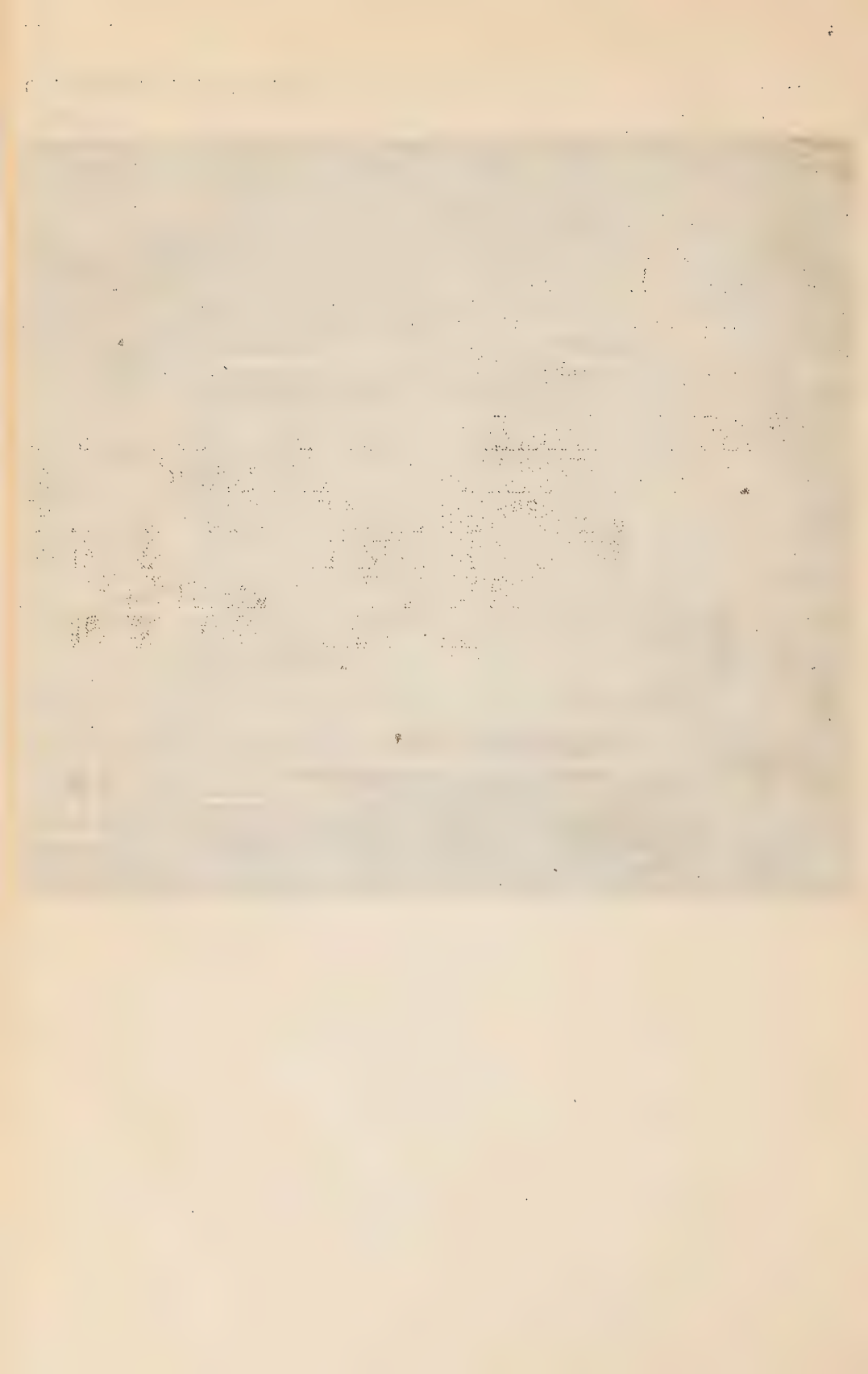
#### INVENTORIES OF PROPERTY.

Real estate at original cost (\$64,800), less sales.....	\$19,261 18
Surface improvements, buildings, stamp mill and dam, cleared lands, tramways, Ontonagon dock, etc.....	39,385 00
Personal property, engines, machinery, tools, materials, and diamond drill.....	57,709 44
Supplies: In store, \$140.30; blacksmith shop, \$1,828.86; farm, horses, and wagons, hay, wood, etc., \$942.00.....	2,911 16
Accounts receivable at mine, \$381.36; and in New York, \$1,524.48.....	1,905 84
Mineral at mine.....	290 46
Cash in hands of agent, \$62.09; and treasurer, \$5,660.06.....	5,722 15
	<u>\$127,185 23</u>
Deduct: amounts payable in New York.....	\$1,337 42
Outstanding drafts.....	1,357 06
	<u>2,694 48</u>
	<u>\$124,490 75</u>

#### TREASURER'S ACCOUNT.

<i>Receipts—</i>	
Cash on hand as per last report.....	\$2,429 86
Sales of copper—Product of 1881, 24,227 lbs.....	4,297 75
Assessment.....	10,000 00
Interest.....	232 05
	<u>\$16,959 66</u>
<i>Disbursements—</i>	
Agent's draft for tributor's wages, etc.....	\$6,365 10
Transportation, smelting, insurance, taxes, general expenses, salaries, etc.....	3,141 28
Carbons for drill.....	1,793 22
	<u>11,299 60</u>
Cash balance.....	<u>\$5,660 06</u>







GENERAL STATEMENT.

*Resources—*

Mineral at mine.....	\$ 290 46
Supplies at store, shops, and farm.....	2,911 16
Accounts receivable at mine, \$381.36; and in New York, \$1,524.48.....	1,905 84
Agent's cash balance.....	62 09
Treasurer's cash balance.....	5,650 06

\$10,829 61

*Liabilities—*

Accounts payable in New York.....	\$1,337 42
Outstanding drafts.....	1,357 06

2,694 48  
\$8,135 13

The capital stock is \$1,000,000, divided into 40,000 shares. The estate consists of 4,653 acres of land, a tract worth careful exploring.

THE RIDGE MINE

Is situated in the S. W.  $\frac{1}{4}$  of Sec. 35, T. 51, R. 38, and the company was organized under a special charter from the Legislature of the State of Michigan, April, 1850, and mining work was begun at that time in what is known as the Butler or Champion lode. The company worked the mine for five years and leased the property to Capt. Stephen Martin, who operated it until 1863. The mine was purchased by Thomas F. Mason for \$200,000 in 1860, who three years thereafter reorganized the company under the general mining laws of the State, with a capital stock of \$500,000, divided into 20,000 shares. Two hundred thousand dollars in assessments were levied and collected during the two succeeding years, since which time the product of the mine has sufficed for the expenses, and dividends to the amount of \$160,000 have been paid, the first dividend, \$50,000, having been declared in 1872.

The Ridge forms one of the Evergreen Range Mines, and has ever been esteemed as one of the best in the district. The estate comprises 1,494 acres of land, and is crossed by all the veins of the Evergreen Range, the value of some of which has never been proved on this property, although found to be productive elsewhere. The present mine is in what is called the Evergreen vein, and it is the desire of Agent Harris that the old mine in the Champion lode be reopened. The formation here is very irregular, both in dip and in trend, the general inclination and bearing being 38° northwesterly, and S. 43° W.

The mining plant is much behind the times, the machinery, having been long in use, needs replacing with newer and improved patterns. The compressor and power drills should replace the slow and expensive hand work. The mine needs a compressor and air drills to extend the openings with greater rapidity than is now possible. If pushed with the same vigor as the Osceola there is but little doubt that the Ridge would be a paying mine.

The following is the report of the Ridge Copper Company for the year 1881:

The product of the mine for the year has been—

	Pounds.
Barrel Copper.....	101,150
Stamp ".....	80,050
Mass ".....	54,540
	<u>235,740</u>

Or 117 1740-2000 tons, which has realized, including mineral remaining at the mine at 80 per cent., yield.....	\$36,233 99
Received from interest.....	142 68

Total receipts..... \$36,376 67

The expenditures of the year have been as follows:

Mine expenses.....	\$33,384 63	
Other expenses, as per Treasurer's balance sheet.....	6,111 71	
		\$39,496 34
From which deduct total receipts as above.....		36,376 67
Shows the loss on the business of the year.....		\$ 3,119 67
The statement of assets and liabilities in last report showed a balance of.....		\$25,969 39
Deduct loss on business of 1881.....		3,119 67
Balance on January 1, 1882, as per statement attached.....		\$22,849 72

The openings made in 1881 were as follows:

Drifting 148 10-12 feet, at an average price per foot of.....	\$9 44
Sinking shafts, 54 5-12 feet, average price per foot of.....	28 00
Stoping 463 67-72 cubic fathoms, average price per cubic fathom of.....	22 01
Making the whole amount of ground broken, 512 18-72 cubic fathoms, which produced about 460 pounds of mineral copper per cubic fathom of ground broken.	

#### STAMPING.

The stamp mill worked seventy days, stamping 2,300 tons of rock, which yielded about 1.74 per cent of mineral copper.

#### WORKING FORCE, ETC.

The average monthly number of employ��s was.....	521½
The average monthly number of miners.....	27
The average monthly wages of miners on contract was.....	\$40 06

#### CONDITION OF THE MINE.

The work done during the past year was confined almost entirely to the vicinity of No. 3 shaft. The shaft was sunk to the 70-fathom level, at which point the vein made a large pocket of very productive stoping ground. The 70-fathom level was drifted a short distance west of shaft, but from want of time no drifting was done at that level east of shaft.

The rest of the drifting done was at the 60-fathom level east and west of No. 3, and at the 50-fathom level east of No. 3 shaft. The only work done in the western part of the mine was a little stoping at the 50-fathom level, just east of No. 2 shaft, and at the 40-fathom level, some 250 feet and 670 feet west of No. 2 shaft. The vein at those places was rather small, but moderately productive of small mass and barrel copper. Some stoping was also done at the 30-fathom level, west of No. 3 shaft. At all these places the vein was generally large and promising in appearance, but sparingly productive of copper.

The principal and most valuable stoping ground was just west of No. 3 shaft, at the 70-fathom level, and just east and west of the shaft at the 60-fathom level. This stoping was mostly in the irregular jumble of vein apparently dipping west, which was spoken of in my last report. The vein here is more than usually twisted and broken, being sometimes but a mere string, and then swelling out into pockets of from 20 to 30 feet in width. The prospect for the continuance of this copper ground is quite favorable, and from its appearance at the 70-fathom level, we may reasonably expect it to grow richer as greater depth is attained.

I would now respectfully call your attention to the advisability of taking immediate steps to introduce machine drills into the mine, and to procure a new hoisting engine and other necessary equipments. We cannot expect to do

our work with desirable economy and to the best advantage unless we have the same kind of appliances and facilities that are now in general mining use. I think that the appearance of the mine will warrant the levying of an assessment for that purpose, and I so recommend.

In laying out any new work I would provide in some measure for the reopening and working of the old mine vein, which could be done, whenever desired, either independent of or conjointly with the present workings. The old mine vein was very productive of copper. It is many years since anything was done there, and far better results could be obtained to-day because of the improved methods and appliances for mining.

I estimate the required outlay approximately as follows:

Hoisting engine, boilers, drums, and gear .....	\$10,000
Air compressor, pump, steam pipes, etc .....	6,000
Pipes for compressor, power drills, shafting, etc .....	2,000
Planer, lathe, drill, small engine for machine shop .....	2,000
Two new shaft houses, skip, wire rope, etc .....	2,500
Building for engine house, compressor, machine shop, etc .....	4,500
Add one-fifth per centum, say .....	5,000
For opening new ground, drifting and sinking .....	8,000
	<hr/>
Making a total estimate of .....	\$40,000

The foregoing does not include anything for the old mine vein, except machinery; nothing for shaft-houses, pumps, and labor for unwatering the mine, straightening and retimbering shafts, etc., etc.

If the above plans are approved, and they are certainly worthy of your serious consideration, I would recommend that for the purposes mentioned, \$50,000 be raised by assessment on the stock. Yours respectfully,

S. B. HARRIS, *Agent*.

The subject of equipping the mine for work on a larger scale, and with modern appliances, has been under the consideration of the board of directors for some years, but they have not hitherto found it in accordance with their judgment to take any steps to that end. The failure for the past two years to show any earnings, now decides the board to submit to the stockholders for their definite action, whether they will assess themselves to provide the equipment necessary to put the mining operation on a profitable basis, as recommended by the agent, Captain Harris. The directors fully concur in his recommendation; and in order that the question may have the fullest consideration, submit this report to each individual holder of stock in advance of the annual meeting, and with it a form of proxy, which may be used by any who cannot attend the meeting in person. If signed and returned to the office of the company, the proxy will be voted in favor of the election of a board of directors, who will assess the stock as herein indicated.

The stockholders are reminded that no election of directors has been held at the last three annual meetings, because a majority of the stock was not present, and did not vote either in person or proxy, as the law under which the company is organized requires; and all are earnestly solicited to see that their stock is properly represented at the meeting, which will be held at the office of the company, No. 4 Exchange Court, New York City, on Thursday, March 2, proximo, at 11 a. m. Unless a majority of the stock is present or represented, no business can be transacted.

All of which is respectfully submitted.

THOS. F. MASON, *President*.

## BALANCE SHEET FROM THE BOOKS OF THE RIDGE COPPER COMPANY, JAN. 1, 1882.

## EXPENDITURES.

<i>Real Estate—</i>		
Cost of property.....		\$203,541 00
<i>Expenditures—</i>		
As per published statement to January 1, 1881.....		1,012,618 70
<i>1881—</i>		
Mining account.....	\$39,550 37	
Smelting.....	2,363 56	
Expenses, taxes, and copper charges.....	2,486 40	
Transportation.....	1,103 70	
Insurance.....	158 05	
		45,662 08
<i>Dividend Account—</i>		
Paid February 24, 1873.....	\$50,000 00	
“ “ 23, 1874.....	20,000 00	
“ “ 8, 1875.....	20,000 00	
“ “ 10, 1880.....	9,742 00	
		99,742 00
<i>Company Stock—</i>		
One hundred shares, costing.....		239 70
<i>Treasurer's Account—</i>		
Cash in bank.....	\$6,020 41	
Call loan.....	10,000 00	
		16,020 41
		<u>\$1,377,823 89</u>

## RECEIPTS.

<i>Capital Stock—</i>		
Paid in for property.....	\$200,000 00	
Assessments.....	200,000 00	
		\$400,000 00
<i>Copper Account—</i>		
Sales to January 1, 1881.....	\$914,149 71	
Sales in 1881.....	47,493 71	
		961,643 42
<i>Interest Account—</i>		
Collected to January 1, 1880.....	\$16,037 79	
Collected in 1880.....	142 68	
		16,180 47
Shipment, 1881.....	289,880 lbs.	
Yield.....	81 per cent.	
Ingots.....	235,606 lbs.	
		<u>\$1,377,823 89</u>

## STATEMENT OF LIABILITIES OF THE RIDGE COPPER COMPANY, AND OF AVAILABLE ASSETS, JANUARY 1, 1882.

## LIABILITIES.

Unpaid dividends.....	\$258 00
Drafts outstanding.....	1,241 02
Accounts payable at mine.....	2,032 13
Balance.....	22,849 72
	<u>\$26,380 87</u>

## ASSETS.

Treasurer's account.....	\$16,020 41
Cash on hand at mine.....	8 95
Accounts receivable at mine.....	292 92
Mineral at mine, 20,130 lbs. at 80 per cent yield and 15 cents per lb.....	2,415 60
Supplies at mine.....	7,642 99
	<u>\$26,380 87</u>

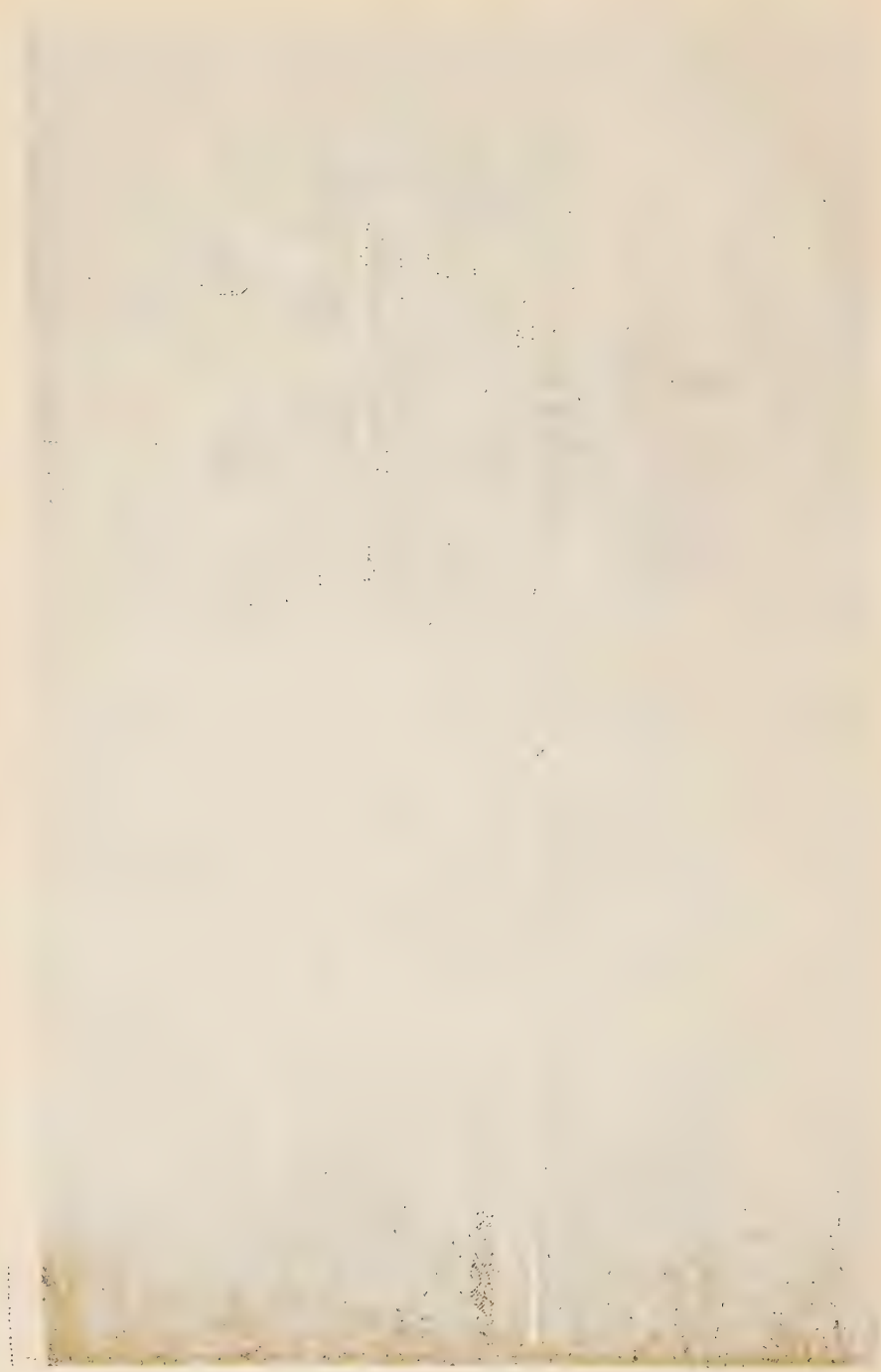
Balance of available assets over liabilities.....\$22,849 72.



LONGITUDINAL SECTION OF THE RIDGE MINE, JAN., 1882.

Scale, 180 ft. to one inch.





The officers are Thomas F. Mason, President; W. Hart Smith, Secretary and Treasurer, No. 4 Exchange Place, New York. S. B. Harris, Agent, Greenland, Michigan.

#### AZTEC MINE.

Work at the Aztec Mine has been continued during the year, driving a cross-cut through the bluff and securing a few tons of copper—five tons 1,880 pounds. The mine is owned by Dr. C. G. Hussey, by whom it was purchased, and in 1880 a new company was organized and Capt. Joseph Huddleston, with half a dozen miners, has since been at work in the mine.

The mine lies east of the Hilton, in the N. W.  $\frac{1}{4}$  Sec. 31, T. 51, R. 27, and the bluff in which it is situated forms one of the Evergreen Range Bluffs. The first copper was shipped in 1852, and the total up to the present time has been about 356 tons. The assessments have been \$150,000, and the estate consists of 1,200 acres of land. The mine can be drained to a considerable depth, by adits. On the location is a stamp mill with ten heads Cornish stamps, a rock house, etc. The work now doing is more in the way of exploration, to cross-cut, and in a measure to prove the lodes. The capital stock is \$1,000,000, divided into 40,000 shares. The officers are August Page, Secretary and Treasurer, Boston, Mass. Capt. John Chynoweth, Agent, Greenland, Michigan.

#### MASS MINE.

At the Mass Mine considerable progress has been made during the past year. For several years it has been the largest producing mine in Ontonagon county, and has been worked to a profit. All the improvements, which are considerable, have been paid for from the earnings of the mine, and no assessments have been called for since 1874. The plan has been to proceed cautiously, avoiding all unnecessary expenditures—in fact the plan is to make the mine pay its own way without calls upon the stockholders for funds, and under the economical management of Capt. Chynoweth the plan has thus far been successfully carried out.

There is scarcely room for doubt but a more liberal expenditure would result in the pecuniary advantage of the owners since the mine openings are too limited to afford a large yield of copper. The product is very uniform and constant, and the percentage of copper is shown to be sufficiently great to afford a handsome revenue if enough of the rock were mined. Until recently the mining has been handwork, and the cost for sinking, drifting, and stoping was brought to too high a figure to leave, with the limited amount done, a large margin of profit. Recently a compressor has been introduced, and power drills are now at work in the mine, which must unquestionably prove of great advantage.

The accompanying report of the superintendent embraces the operations of the mine for the year ending December 31, 1881, and the last commissioner's report contains a very full description of the mine, and of its operations up to that time. The work for the year 1881 showed a decrease in product during a portion of the year; this, with the low price of copper during the early part of the season, brought down the receipts. The expenditures were increased by the purchase of new machinery.

The amount of mineral on hand at the opening of the year was 49,930 pounds, which produced 43,938 pounds ingot, and the amount of mineral

obtained from November 1, 1880, to November 1, 1881, was 620,914 pounds, all of which was shipped from the mine; of this, about 530,000 pounds, smelted, yielded 383,886 pounds of copper, making the total amount obtained 427,824 pounds, which sold for \$70,895.84, leaving 90,000 pounds of mineral on hand. The forfeited stock of the company, which had been bought in and held, was divided pro rata among the stockholders.

TREASURER'S REPORT OF RECEIPTS AND EXPENDITURES TO DECEMBER 1, 1881.

RECEIPTS.

Assessments paid in.....		\$149,202 00
Sales of copper to date of last report.....	\$292,531 17	
Sales of copper since date of last report.....	70,895 84	363,427 01
Debts due.....		9,634 43

\$522,263 44

EXPENDITURES.

General expenditures to December 1st, 1880.....	\$423,141 48
Labor drafts paid.....	87,579 15
Taxes.....	671 11
Interest.....	8 98
Expenses.....	1,407 43
Freight.....	1,808 50
Insurance.....	570 50
Smelting.....	3,876 75
Due from sundry parties.....	221 84
Cash on hand.....	1,977 70

\$522,263 44

LIABILITIES.

Labor drafts outstanding.....	\$ 6,788 03
Debts due.....	9,634 43

\$ 16,422 46

CASH ASSETS.

Cash.....	\$ 1,977 40
Ninety thousand pounds mineral, estimated value.....	12,000 00
Due from sundry parties.....	221 84

\$14,199 24

The Superintendent's report of the mining operations is as follows:

The operations are still confined to the Knowlton vein, and consist of

Drifting 511 feet 5 inches at a cost per foot of \$13.11.....	\$6,709 81
Sinking winze 79 feet 9 inches at a cost per foot of \$15.58.....	1,198 75
Sinking shafts 137 feet 9 inches at a cost per foot of \$22.02.....	3,037 82
Stoping, 1,335 cubic fathoms at a cost per cubic fathom of \$13.12.....	17,514 54
Sundry work.....	4,133 51
	\$32,594 43

The number of men employed and the amount of wages expenses were:

Sixty-one and four-tenths miners and timbermen.....	\$32,594 43
Fifty mechanics and laborers.....	22,488 56
Total wages.....	\$55,082 99

Additional expenses incurred, as follows:

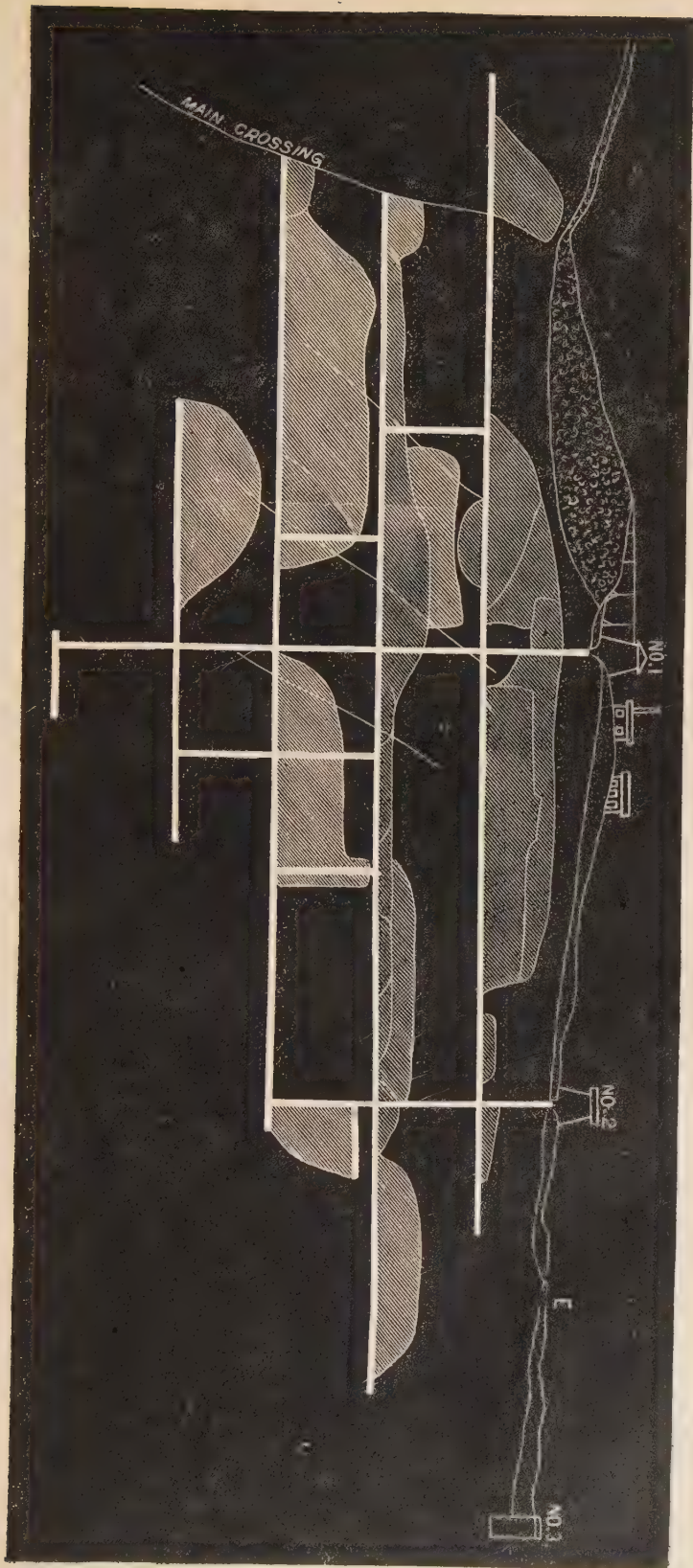
Three thousand cords of wood.....	\$6,221 00
Mining supplies consumed.....	2,584 80
Amount paid for machinery.....	10,676 68
All other expenses, including transportation, taxes, salaries, etc.....	8,840 72

Total expenditures for the year..... \$83,406 19



LONGITUDINAL SECTION OF THE MASS MINE, JAN., 1882.

Scale, 120 ft. to one inch.





The results of the leading features connected with the works, are shown in the following statements:

Total amount of rock mined.....	22,500 tons.
Amount hoisted to surface.....	20,064 "
Amount selected for stamping.....	7,761 "
Cost of selecting, delivering and stamping.....	\$10,489 62
Amount of mineral produced from stamps.....	318,665 lbs.
Amount of masses and rough mineral produced.....	302,249 "
Total mineral product.....	620,914 "
Amount of mineral per cubic fathom of rock.....	465 "
Proportion of masses and barrel work to whole product.....	48 67-100 $\frac{3}{4}$ cent.
Proportion of stamps copper to whole product.....	51 33-100 "
Proportion of stamp rock to whole amount mined.....	34 50-100 "
Percentage of mineral in selected stamp rock.....	2 05-100 "
Percentage of mineral in whole amount of rock mined.....	1 37-100 "

The facilities for economical mining have been greatly increased during the past year by the erection of an air compressor, and the introduction of the Rand air drills.

We have nine of these drilling machines now on hand, seven of which are employed in stoping.

These machines will soon be started in the drifts and shafts, and, with the great expedition in making openings by this means, a large amount of stoping ground can be prepared for breaking with a comparatively small force.

With these improvements, the amount of rock mined will be nearly doubled, and the scale of operations and degree of success correspondingly increased without much additional working expense.

Where the air drills are used we find it necessary to employ high explosives exclusively for blasting, which largely increases this item of mining cost; but the data that we have been able thus far to obtain indicates that the cost of producing each ton of rock is reduced nearly one-half.

The No. 1 shaft is now down to the fifth level, and drifting commenced at that level. The vein in this locality shows considerable copper, and for that reason we think it advisable to resume the sinking at an early date.

The No. 2 shaft is sunk to the third level, and has a communication from that point westward to No. 1 shaft.

The vein at the bottom of No. 2 shaft has yielded some stamp rock, and a large proportion of masses and barrel work.

We still have considerable stoping ground opened, but the openings should be vigorously pushed ahead; not only to keep up the supply, but for the purpose of discovering other valuable deposits of mineral.

With reference to the general appearance of the mine, and its prospects, I would say that during the past year no material change has taken place. The vein throughout the lower levels has settled into a sameness of character and production. Since the exhaustion of the large surface deposits of mineral there has been a decrease in the quality of the vein matter, but it has now apparently settled into a condition in which the yield of copper will be in about the same proportion as it has been during the past year.

Our success will now depend upon the result of the recent introduction of drilling machinery, and as the new mode of working is now well established, it is reasonable to expect a largely increased product with very little additional expense.

We are provided with a stock of mining supplies, consisting of feed, iron, nails, etc.; for winter's use, amounting, per inventory, to \$2,800.

There are also on hand 200 cords of wood, valued at \$500, besides several hundred cords in the woods, cut on this winter's contract.

It is very desirable to have seasoned wood for consumption, and for this reason we have made arrangements for a larger supply than usual, and shall endeavor to have delivered, during the coming season, five or six thousand cords. Yours truly,

JOHN CHYNOWETH, *Superintendent.*

The Mass Mine location is the S. W.  $\frac{1}{4}$  of Sec. 6, T. 50, R. 38, and the company was organized in 1856, with the President, then as now, Dr. C. G. Hussey. The other present officers are James W. Brown, Secretary and Treasurer, Pittsburg, Pa. John Chynoweth, Superintendent, Greenland, Mich,

The capital stock is \$500,000, divided into 20,000 shares.

The product for December, 1881, was 37 tons, 120 lbs. The product for January, 1882, was 38 tons, 1945 lbs. The product for February, 1882, was 38 tons, 1214 lbs.

No. 1 shaft—the working shaft—has been sunk to the 5th level, about 360 feet from the surface, on the lay of the vein.

The other mines in the Evergreen Range have continued idle since our last report with the exception of a limited amount of tribute work having been done at a few of them.

The Ogima produced 8 tons and 259 pounds.

The Flint Steel produced 3 tons and 668 pounds.

The Evergreen Bluff produced 0 tons and 1210 pounds.

The Adventure produced 0 tons and 9614 pounds.

No changes observable have been made in any of these mines.

#### INTERNATIONAL.

The sale of the International—Old Bohemian—is reported. The sum paid is stated as being \$50,000. This mine adjoins the Aztec, being the E.  $\frac{1}{2}$  Sec. 31, T. 51, R. 37. The first copper shipped from it was in 1853, and the estate comprises 1,480 acres of land. Considerable money has been expended on the property in past years.

#### THE WINONA,

It is said, has also been sold, through the agency of Messrs. Kruse & Traverse of Chicago. Some men were put to work in the winter to clean out the pits, etc., to prepare the property for examination.

#### HARTFORD.

At the Hartford location, Sec. 32, T. 50, R. 40, some work has been done within the past year under the direction of the owner, Wm. H. Stevens of Detroit. The indications are said to be favorable and a company has been organized to work the property.

#### NONESUCH.

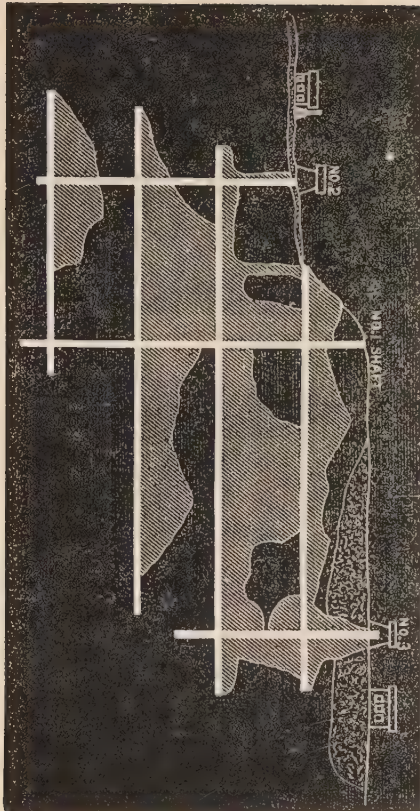
Early in 1881 the Nonesuch Mine was sold; the purchasers also bought out Capt. Hooper's lease. Preparations were immediately made for future mining



LONGITUDINAL SECTION OF THE KNOWLTON MINE,

JAN., 1881.

Scale, 180 ft. to one inch.





LONGITUDINAL SECTION OF THE EVERGREEN BLUFF MINE,  
ONTONAGON COUNTY, MICH., 1881.

Scale, 250 ft. to one inch.

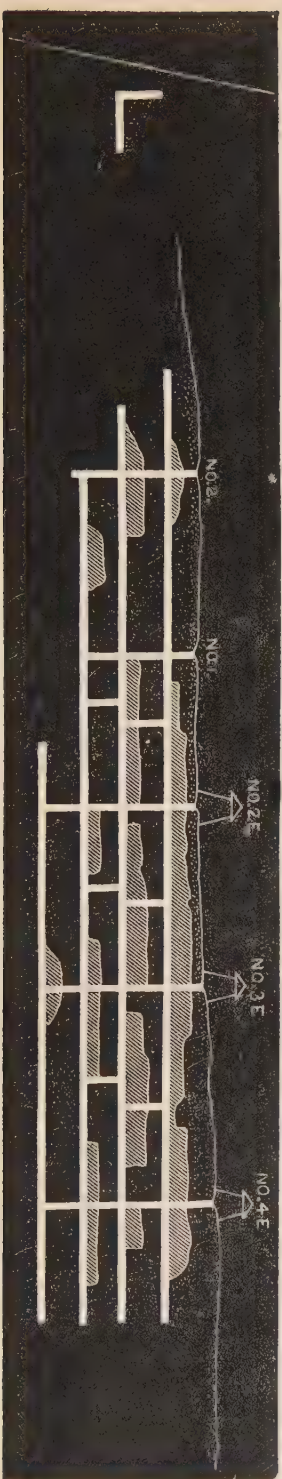






LONGITUDINAL SECTION OF THE TOLTEC MINE,  
ONTONAGON COUNTY, MICH.

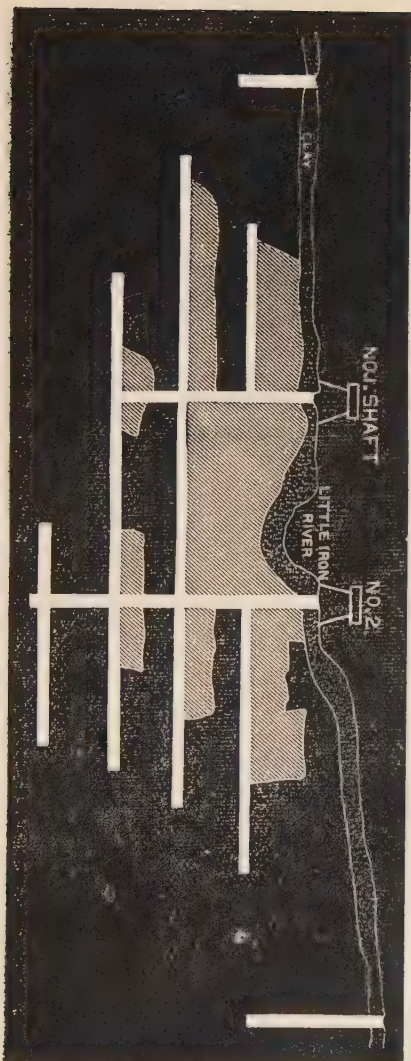
Scale, 300 ft. to one inch.





# LONGITUDINAL SECTION OF THE NONE-SUCH MINE.

Scale, 200 ft. to one inch.







on a large scale, and within the year much surface improvement has been made. The progress of the work has recently been somewhat delayed, awaiting the results of trials and experiments which were made in testing the rock. Several tons of the rock were sent to the smelting works at Portage to be tested in the furnaces, and a like amount was shipped to Chicago for chemical manipulation.

The chief improvements which have been made consist of engine house, stone and iron, 42x50 feet, in which has been erected a hoisting engine, Hodge's pattern, 24x36 feet, 250-horse power.

The upper floor of the new engine house is fitted up for a machine shop, provided with planer, lathe, bolt cutter, etc., all of which are run by an engine on the same floor.

The new boiler house is 48x52 feet, also of stone and iron. In it are placed three large boilers and two smaller ones, to furnish steam for hoisting engine, compressor, and stamp mill.

The new compressor is Rand duplex, 16½x20 feet, and will suffice for forty air drills.

There are two hoisting drums, Hodge's pattern, ten feet diameter, friction gear.

The new stamp mill in process of erection is to be 130x67 feet, in which will be placed the three Ball stamps now on the ground. Adjacent to the stamp mill will be placed the rock house. The compressor is ready to work and 16 drills have been procured.

Fifteen new dwellings have been built; also a store, office, hotel, etc., making twenty buildings in all.

The tram road to the lake has been completed and laid with T rail most of the way, the intention being to use a locomotive to operate the road. Two ware houses have been built at the lake terminus of the road—Union Bay—and the dock has been enlarged and improved.

Very little sinking or drifting has been done in the mine. A limited number of miners have been at work stopping sufficient rock to supply the stamps and washing mill. A product for the year of 104½ tons of mineral have been obtained, yielding 60 per cent ingot.

About 120 men are employed.

Capt. Hooper states that it is possible that the building of the stamp mill, the foundations of which are laid and the materials for the completion of which are on the ground, will be abandoned, and a system of rollers, grinders, sieves, and jiggers substituted. The stamp heads pound the rock up too finely, thus making a great deal of slime from which it is impossible to mechanically separate but a portion of the copper. The experiments made with rollers in treating rock show that they do not make slime. This is shown to be the fact at the Petherick Ash Bed, where they are now treating 25 tons per day with rollers and Hodge grinders. Much of the copper in the Nonesuch rock is too fine to be saved by any process of washing now in vogue, especially if a sufficient quantity is treated to make a large mining business. It is said that while the experiments made at the smelting works were not sufficiently favorable to induce the adoption of that method to separate the copper, still a greater percentage of copper was obtained by smelting the rock than by manipulating it in the stamp mill, but it is declared that this process would prove too expensive and that the chemical manipulations proceeded with in Chicago gave much more favorable results, both as to quantity of yield and the cost of obtaining the copper.

The plan which the company now think of adopting to separate the copper will be a process partly mechanical and partly chemical. By the rollers, grinders, sieves, and jiggers a certain degree of separation will be effected which will be completed by a process of chlorination, precipitation, and roasting, the details of which they have not made known. It is nearly decided to sell the new, unused machinery for the stamp mill and to commence the erection of the works for carrying out the newly devised plan.

Certainly experiments of such a magnitude as this which is contemplated, and the corresponding delay occasioned, are expensive and vexatious; but there is no doubt but some better plan should be devised for treating this rock than the use of stamp heads. As to that matter, it is an open question whether a better process than the use of stamp heads could not be adopted in any of the mines.

#### THE WHITE PINE MINE.

Working, or rather exploring, the Nonesuch lode, two and a half miles distant from it, to wit: on Sec. 5, T. 50, R. 42. The land is leased from The Ship Canal Company. A shaft has been sunk 60 feet in the lode and the deposit is in all respects similar to that at the Nonesuch. The work was begun in the fall of 1880 by Byron White and John Parker of Ontonagon village, who have sold out to Chicago parties. One-half ownership of the lease is now held in Chicago, and the other half by Capt. Thomas Hooper.

#### KEWEENAW COUNTY.

##### THE CONGLOMERATE MINING CO.

The Conglomerate Mining Company, Keweenaw County, has accomplished a great deal of work both on the surface and underground during the past year, or since its organization in January, 1881. It has become the most conspicuous of the Keweenaw County mines. Three hundred and fifty thousand dollars have been expended, \$145,000 of which sum has been incurred for new mining plant, and for new houses and store, etc.

The new openings are all in the wide conglomerate underlying the greenstone—Allouez Conglomerate—and are very extensive considering the time that has been occupied in making them. This new mining work has been greatly facilitated from having the old Northwest Mine from which to drift and to hoist, etc.

The drifts in the Northwest Mine extend to the green stone, through the conglomerate, and so the work in the conglomerate could be readily prosecuted from this mine.

Besides the Northwest the new mine is opened with three working shafts and two surface winzes. The formation here runs east and west, and the shafts are numbered with reference to their position from the old mine. One shaft, situated west of this mine, is called No. 1 west; it is 330 feet from the old mine, and is sunk to the first level, 110 feet in depth, measured on the incline. No. 1 east, is 660 feet from No. 1 west, or 330 feet east of the old mine; it is sunk to the fourth level, or to a depth of 447 feet. No. 2 east is a winze, and is 520 feet east of the old mine; it is sunk to the second level, or to a depth of 233 feet. No. 3 east is 790 feet east of No. 1 east—1,020 feet east of the old mine; it is sunk to the second level, or to a depth of 290 feet.

No. 4 east is a winze, and is 420 feet east of No. 3 shaft, and is sunk to a depth of 2,207 feet, so that the distance between the extreme shafts is 1,540 feet; the shafts are all connected in the adit level.

The lowest level is the fourth below the adit, and all the levels are run east and west from the old mine, all intersect No. 1 shaft, east. No stoping has been done, and all the product, since work ceased in the old mine, in April last, has come from the new openings. The belt is wide, 12 feet to 20 feet and upwards in places, and as it runs rich and poor in streaks as well as in bunches and shoots, its probable yield cannot well be determined. So far the percentage of the copper obtained from the rock taken from the openings has been low; too low to afford any encouragement of ultimate financial success, unless the rock from the openings prove to be below the average of the lode, or unless, hereafter when the openings are made, the productive ground be selected and the openings be kept well ahead to enable the selection of stoping ground to be advantageously made. It is the plan of the management to have the mine extensively opened, so that when the new stamp mill shall be built the mine will be in condition to keep the stamp heads at work.

West of the fissure vein—old Northwest Mine—may be seen in the conglomerate a fine stretch of copper ground. This shoot pitches to the west. There are other good shoots of copper to be seen in the mine, but withal there is much poor ground, too large a proportion, to all appearances, to make one feel perfectly sure that the owners will realize the results which they anticipate.

Everything is thoroughly and substantially done. The new store is the best in the county; the new compressor is of stone and iron, and the duplex Rand compressor, which has been erected therein, has been placed to stay. The cylinders are 24x48, and suffice for fifty drills. It cost \$20,000, and with building, cost \$63,000.

The boilers are Babcox & Wilcox, a peculiar pattern, made up of pipes in sections. There are two—320-horse power—for the compressor, and two boilers of same size and pattern have been placed in the stamp mill. The hoisting in No. 1 and No. 3 shafts is done with two small engines. A new pump has been placed in the stamp mill. Eighteen new dwellings have been built and substantial shaft-houses erected. Elevated railway tracks connect the several shafts with the main track leading to the rock house, and the hauling will be done with a small dummy engine, which has been procured for the purpose. The cars will discharge into the rock house from the side, the cars themselves being made to dump sidewise.

The total length of the drifting which has been done in the tenth level is 658 feet; total drifting in the 20th level is 476 feet; in the 30th level it is 472 feet, and the total cross-cutting is 73 feet. (March 1, 1882.) Contract miners make \$2.17 per day; company account miners received \$1.74 per day, and underground laborers \$1.43 per day.

Contract for drifting by hand costs \$16.65 per lineal foot; contract for drifting with drills costs per lineal foot, \$11.11, which includes only the price paid the men. Sinking by hand, \$16.97 per foot; sinking with drills, \$14.75 per foot, which includes what the men are paid per foot, the company furnishing the power and the men paying for supplies.

Average number of miners employed was 94 and the average number of underground laborers other than miners was 28; boys employed underground, 7.

Cost of compressor power per foot of drift was \$2.52; cost of compressor power per foot of sinking was \$3.31.

A party of six men average in drifting, by hand, 26 8-10 feet per month, size 7x7 feet.

With power drills a party of four men and one boy average, 43 1-10 feet per month, the size of the drift being 8 feet wide and 12 feet high. Drifts made with power drills are nearly always larger than when made by hand drills.

Six men sinking winzes by handwork, accomplished 23 6-10 feet per month; four men and one boy with power drill averaged 32½ feet of shaft sinking per month. The winzes were 7x8 feet in size, and the shafts were 8x13 feet.

Comparison of cost of drifting in the conglomerate by hand drill work and with power drills:

Contract cost per foot of measured length of drift—hand work, 1881.

Wages .....	\$13,238
Supplies .....	3,415
	<hr/>
	\$16,653
Cost of sharpening drills .....	436
	<hr/>
	\$17,089
Less 25 per cent profit on supplies .....	854
	<hr/>
Total cost per foot .....	\$16,235

Cost of drifting per foot with power drills, 1881. Cost on conglomerate, Rand drills, per foot.

Contract cost per foot—wages .....	\$5,776
Supplies .....	5,338
	<hr/>
	\$11,114
Cost of running compressor, including repairs on compressor, drills, etc. . .	2,162
Cost of sharpening drills .....	387
Interest on compressor plant .....	434
	<hr/>
	\$14,097
Less 25 per cent profit on supplies .....	1,334
	<hr/>
Total cost per foot .....	\$12,763

The interest on compressor plant was figured, on \$18,000, \$15,000 invested in large compressor, boilers, piping, etc., and \$3,000 invested in small compressor—Bowers—manufactured by Griffith & Wedge.

The cost of sinking, per foot, of shafts, including all items, is as follows—Rand drills.

Contract wages .....	\$9,300
Supplies .....	5,456
Drill sharpening .....	509
Interest on compressor plant .....	571
Compressor, cost for fuel, attendance, etc. ....	2,343
	<hr/>
	\$18,179
Less 25 per cent. profit on supplies .....	1,364
	<hr/>
Total cost per foot .....	\$16,815

Using the same figuring for hand work as against the power drills the cost per foot would be \$30.



Items of cost for stoping on the amygdaloid in the Northwest Mine, with Rand power drills.

	Stoping contract by the fathom.	Contract by the foot of hole drilled.
Days' labor per fathom (men).....	\$2 38	-----
" " " " (boys).....	98	-----
" " " " (miners).....	-----	\$1 71
" " " " (blasters).....	-----	35
" " " " (boys).....	-----	60
Contract wages per fathom stoped.....	5 54	3 30
Wages paid to blaster and helper.....	-----	1 06
Supplies used by miners.....	8 77	33
Supplies used by blasters.....	-----	6 21
Compressor cost per fathom stoped.....	1 79	1 28
Interest on compressor cost, plant.....	67	48
Total cost per fathom stoped.....	13 77	12 76
Less 25 per cent profit on supplies furnished.....	1 44	1 63
Final cost per fathom.....	12 33	11 03
Amount of rock broken per one drill and four men.....	43 70	60 80
Wages earned by miners per day.....	1 93	1 68

The contracts were let per foot of hole drilled, the men furnishing light, oil for drilling machine, and the company furnishing power, drills, caps and fuse, also the charger, who measured the depth of the hole when he inserted the charge.

The men were paid twelve cents per foot of hole drilled. In contracts by the fathom the men paid for all supplies and the company only furnished drills and power to run them.

The cost of stamping and washing a ton of rock, including repairs, \$1.10.

Rock house expense, including cost of carrying to rock house, per ton of rock, 35 cents.

Average number of tons stamped per day for 10½ months, 100. Total product for the year, 235 tons 1,708 pounds, mineral.

The machinery for the new stamp mill has been purchased, which includes 3 Ball heads, procured at the Cuyahoga works, Ohio, each 18-inch cylinder and 10-inch shaft, having a capacity of 200 tons per day of rock for each head.

The location of the mill has not yet been definitely decided upon. If placed at Lac La Belle, the long talked of railroad will have to be constructed, about seven miles. It is doubtful if any better plan can be devised than to carry out this original project. If 600 tons of rock per day are to be treated, access must be had to the lake; there is not sufficient water otherwise.

The fuel used under the boilers is cord wood, which costs \$3.25 per cord for maple and birch, etc. The total number of men now employed is about 350.

It is apparent from the preparations which have been made and are making, that the managers have abundant faith in the mine. The estate is a very large one, exceeding 20,000 acres of land, and the history of the mining enterprises which have heretofore been inaugurated to work portions of it, chronicles no success. It is certainly to be hoped that the Conglomerate is not doomed to a like fate. But it illustrates the vast preliminary expenditure which must, in all cases, in a measure, be necessarily incurred, and the uncertainty of copper mining, even at this late day, and in Michigan, when a mine

as the "Conglomerate," shall have, perhaps, expended two-thirds of a million of dollars before the richness of the deposit of which all this expenditure is based, shall be definitely determined.

If the project of building the railroad to Lac La Belle is abandoned, and the stamp mill is erected upon the site of the present one, or near it, much of the preliminary cost, otherwise necessary, will be curtailed; but on the other hand the mine will be correspondingly crippled. Undoubtedly the future success of the Conglomerate will depend upon working up a large amount of the rock, and that can only be accomplished by having the most ample stamping and washing facilities, which cannot be secured without recourse to the lake. Under the present methods of separating the copper from the matrix the successful operating of the Conglomerate Mine upon the scale contemplated renders the building of the projected railroad, or its equivalent, apparently, a necessity. However the work at the mine is being vigorously pushed, both on the surface and underground, and there is no sham about any of it. Everything is thoroughly and substantially done. The description of the estate is as follows: Secs. 13, 14, and 15, T. 58, R. 30, Keweenaw County, Mich. 100,000 shares. Capital, \$2,500,000. H. C. Davis, President; Charles M. Foulke, Treasurer; George H. Lewars, Secretary; Alex. P. Thomas, Superintendent; James Hoatson, Mining Captain. Philadelphia office, 205 Walnut Place. Mine office, Delaware Mine, Keweenaw County, Michigan.

The following interesting items of comparison of hand drill work and of power drill in the Northwest Mine were furnished by Mr. Frank Klepetko, engineer of the mine. To the same gentleman I am much indebted for the preceding data of the working of the mine.

The table and comparison between drifting by hand and drifting with Rand drills is based on the average work done during 1880 at the Northwest Mine, Keweenaw County, Michigan, the property, at that time, of the Delaware Copper Mining Company. The drifting was done on the amygdaloid belt, which underlies the first conglomerate below the greenstone, and is separated from it by about 130 feet of trap. The wages were high on account of the mine not having been working regularly for some time, and consequently higher rates of wages had to be offered to induce men to come there to work.

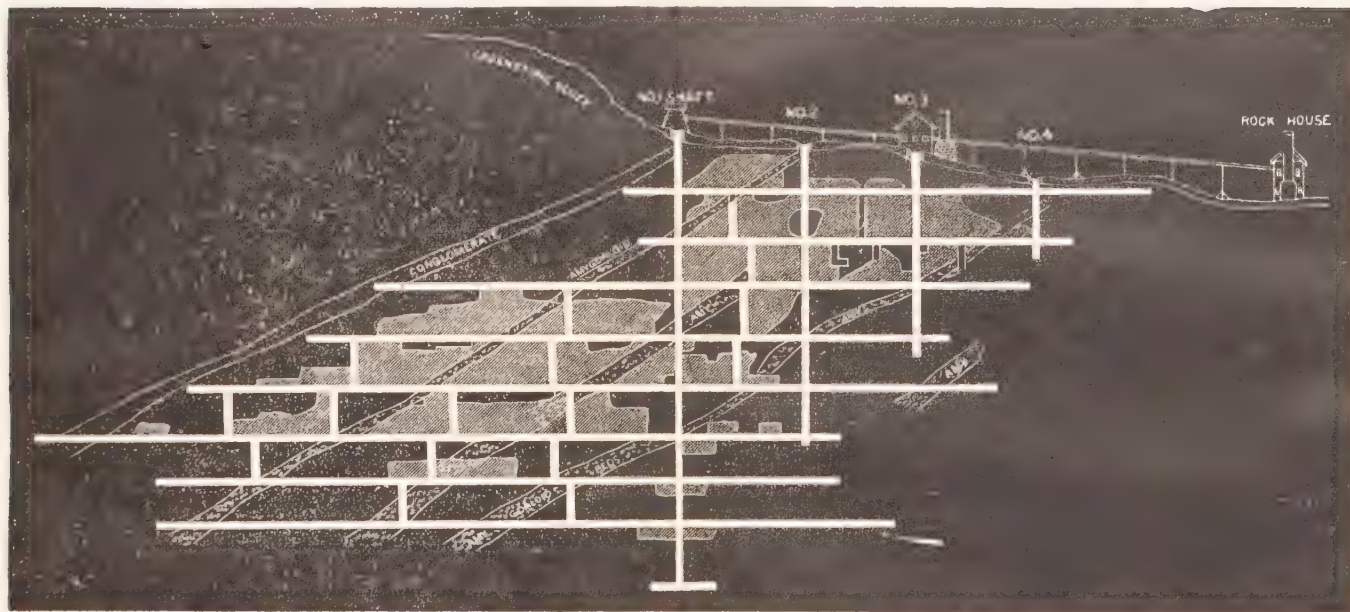
The compressor cost includes repairs on compressor and drills, wages of man running compressor, fuel, oil, packing, etc. The cost per foot drifted was obtained by dividing the compressor cost for the seven months that the drills were running by the entire number of shifts worked by miners with the drills. This quotient was multiplied by 2.18, the number of shifts to each foot drifted. The product is the compressor cost per foot drifted. The cost is high because the full number of drills was not run continuously. The repairs again make it lighter, as the compressor plant was new.

The interest on compressing plant was obtained by reckoning interest at 10 per cent. for seven months on \$15,000, which was estimated to be the construction cost of the entire compressing plant, including compressor, boilers, receivers, pipes, and ten drills.

The interest per foot of drift was obtained in the same manner as the compressor cost per foot of drift. The table here given will show more clearly what is meant:

VERTICAL SECTION OF THE DELAWARE MINE (CONGLOMERATE MINING Co.), JAN., 1881.

Scale, 240 ft. to one inch.







	Drifting by Hand Drills.	Drifting with Power Drills.
Days labor per foot (men).....	\$4 79	\$2 18
“ “ “ “ (boys).....	53	53
Advance per month—104 shifts—No. of feet drifted.....	21 07	47 07
Comparison in speed.....	1	2 2
Contract cost per foot.....	\$11 95	\$10 04
Supplies per foot—cost.....	\$2 07	\$4 12
Profit on supplies, 25 per cent.....	52	\$1 03
Net contract cost per foot.....	\$11 43	\$9 01
Compressor cost per foot.....		\$1 64
Interest on compressing plant.....		62
Total cost per foot.....	\$11 43	\$11 17
Wages earned by miners per day (men).....	\$2 06	\$2 50
“ “ “ “ “ “ (boys).....		96

From the table we see an advantage of 26 cents per foot in favor of drifting with power drills. This would be the advantage in cost per foot if the drift passed through poor ground which it did not pay to stope. If the ground were to be stoped an additional advantage would result from the fact that the machine drift is carried larger in section than the hand drift. Let us see what this amounts to.

The hand drift is carried 6x5 feet, and in a length of 100 feet there is broken 3,000 cubic feet of rock.

The machine drift is carried 7x8 feet or more, and in a length of 100 feet there is broken 5,600 cubic feet of rock, or 2,600 cubic feet more than in the hand drift. This is equal to 12 cubic fathoms, which the undercutting stope would not have to break. This would have cost during 1880, \$15 per fathom, especially in such a narrow belt as the Northwest amygdaloid, 12 fathoms @ \$15=\$180, or an advantage of \$1.80 per foot in the machine drifts being carried larger. This amount must be subtracted from the cost per foot of machine drifts, which brings down the final cost to \$9.37 per foot with machine driven drifts against \$11.43 per foot with hand drifts, or an advantage of \$2.06 in favor of drifting with power drills.

The extra speed in drifting and sinking with power drills reduces the the fixed expenses per foot. With power drills an amount of opening can be accomplished in one year, which will take 2.2 years to accomplish by hand drilling. The fixed expenses, such as salaries of officers, pumping cost, etc., and which do not vary appreciably with the amount of work done, amount to at least \$10,000 per year. Hence the power drills will result in a saving of \$3,000 per year on the fixed expenses. At this rate it would not take very long for a compressing plant to pay for itself.

In stoping with power drills the speed is still greater, about four times as much ground being broken by a party of men with a drill as by the same number of men without it.

We must here remark, before leaving the subject, that for the purpose of making the case of handdrifts as favorable as possible, we took the size of the machine drift, the minimum that it is or can be carried. Usually the drift is about 8x9 feet. This would make the extra amount of rock broken in a length of 100 feet, 19.4 cubic fathoms, which at the rate of \$15 per fathom=\$291, or \$2.91 per foot to be subtracted from the cost of the machine drift. This gives for the cost of the machine drift \$8.26, or \$3.17 less than the cost of the handdrift.

The rate of \$15 per fathom for the undercutting stope is also a low estimate for breaking by hand, taking into account the high rate of wages ruling during 1880.

#### THE MADISON.

At the Madison Capt. Joseph Snell continues work with a small force of men in the east vein in the north end of the mine, about 350 feet below the surface. The two veins are perhaps branches or splits of a main fissure, which will probably intersect at about the fifth level. The men are now working in the fourth level. It is expected that at the line of intersection rich copper ground will be found. Experience in the Lake Superior copper mines indicates that this conjecture is almost certain to be verified. The juncture of branches, contracted places in the lode, occasioned by bends or angles, are sure to be productive portions, and it is on their faith in such a result that the hope of the Madison people is based. The mine is on the W.  $\frac{1}{2}$  of Sec. 19, T. 58, R. 30, in Keweenaw County, though the company owns 2,000 acres of land, about 1,500 acres of which is valuable wood land. The mine lies south of the greenstone, and is worked in a fissure vein, and has been more or less worked since 1852; a good deal of money has been expended in times past at this mine, but no profit obtained for the company. There is no stamp mill now on the property, but the little Montreal River furnishes a moderate supply of water here, as at the other mines on the south side of the range in this neighborhood, for operating a mine. About 4,000 tons of stamp rock have accumulated, but no copper has been shipped from the mine in the last year.

The first organization was effected in 1852 under the title of the Summit Mining Company, which company having failed, a reorganization was made in 1859 as The Madison Mining Company. A second failure resulted in the organization of the present company, in 1879, with a capital stock of \$1,000,000, divided into 40,000 shares.

An assessment of 25 cents per share was made in 1881. The present officers are Chas. LeSier, President, Detroit; John W. Betcher, Secretary and Treasurer, Boston; Joseph Snell, Agent, Hancock, Michigan.

#### THE CENTRAL.

Next in order of the active mines in Keweenaw County, and operating south of the greenstone, is the Central, which for a number of years past has continued the leading mine in production, of those of Keweenaw County; the only mine, in fact, since the days of the Cliff, that has regularly returned dividends to its stockholders. The location comprises the E.  $\frac{1}{2}$  Sec. 23, T. 58, R. 30, and the fissure vein, in which the mine is worked, was discovered, (in 1854) as is described very fully in the report of 1880; in the following year the vein was worked and yielded copper in value considerably in excess of the total cost of working;—the first instance of the kind that has occurred. Since that time the value of the copper sold from the mine amounts to upwards of \$7,000,000, and the stockholders have received in return for an original outlay of only \$100,000, the net sum of \$1,664,000. Surely a good showing.

Never, until now, since the opening of the mine has there been a cessation in the occurrence of the great masses of copper for the production of which the Central has so long been famous. The mine has attained considerable

depth—about 2,000 feet vertical—but has, as compared to many other leading mines, a limited lateral extent. The drifts above the 100-fathom level extend nearly to the greenstone, and this space above that drift and north of No. 4 shaft proved very productive ground; but below the hundredth level, the copper has all been obtained from within the limited space between No. 4 and No. 2 shafts, which are distant apart about 600 feet. Below the hundred and twentieth level no ground has been stoped north of No. 4, and but very little south of No. 2 shaft. An inspection of this ground, that has proved so productive in copper, shows that it has a pitch to the south as it goes downward, at an angle of, perhaps,  $20^{\circ}$  from the vertical. The hundred and twentieth, hundred and fortieth, and hundred and sixtieth levels have been pushed to the north a few hundred feet, but the great space, in these lower levels, between No. 4 shaft and the greenstone, is practically unexplored ground. In fact the Central Company has done very little exploring. The mining has been characterized by an abundance of masses in continuous succession, so that there has been very little opening done in advance of actual stoping. The ground opened was nearly all stoped out, so that now when the mine unexpectedly fails to afford its accustomed yield of masses they are confronted with the fact that there is little new opening, and also that the mine has been so little explored that a doubt necessarily arises as to the direction in which it is best to push forward. The necessity of acceleration in the matter of sinking and drifting has caused the management to procure and put into operation a compressor, which has been recently erected in a stone building constructed near the pump shaft. The compressor is a Rand duplex,  $16 \times 30$ , and they are now running five power drills, though the compressor has a capacity of 18 drills. Previously the drilling has all been hand work. A Burleigh drill was used, however, many years ago, in this mine, in sinking the incline shaft. They have sunk two lifts within the past year, and are going down to the third, so that the mine is opened to the 220-fathom level, and will soon be to the 230-fathom. In the 220 they have drifted north and south from No. 4 a distance of about 50 feet each way. The shafts go down vertically, but the vein inclines slightly to the east, so that the drifts are connected with the shafts by cross cuts. These cross cuts lengthen with each successive lift. The vein varies from a few inches to several feet in width, and while at present it carries but little copper it has a “healthy,” “promising” look; but for the first time in the history of the mine there is no mass copper to be seen. The vein here, as elsewhere, south of the greenstone, is crossed by numerous amygdaloid beds, as well as by several conglomerate belts, the south one of which, probably, corresponds to the Calumet Conglomerate.

These amygdaloid “floors” and the south Conglomerate, which latter is, of course, the lowest underlying one yet reached, prove to be productive in copper for a limited distance east and west from the vein. The largest portion of the product now being taken from the mine comes from the south conglomerate and the “Osceola amygdaloid,” so called from the fact that, assuming the conglomerate to be the Calumet, the amygdaloid occupies the same relative position to it here as the Osceola amygdaloid does to the Calumet lode in the mines at Portage Lake. The conglomerate has a width of about 4 feet, and is very rich for a distance of about 30 feet each way from the vein, when it ceases almost wholly to be productive. The character of the conglomerate changes abruptly; it is plain to observe the line of demarkation



between the copper bearing portion of the lode and the point where it ceases to be so.

The "man engine" is down to the 170-fathom level, and will be extended to the bottom of the mine during the present year. A couple of small hoisting engines are in use in the bottom of the mine in lowering the shafts. The product of the mine for the year 1881 is as follows:

	Barrels.	Tons.	Pounds.
Stamp work.....	668	448	670
Kiln copper.....	132	207	1015
Masses.....	163	295	760
Total yield of the mine.....		951	1445

The details of the work are as follows:

No. of feet of shafts and winzes sunk, 307 5-12, average cost per foot.....	\$29 81
No. of feet of drifting on vein, 1,695 3-12, average cost per foot.....	11 84
No. of feet of drifting on conglomerate, 83 3-12, average cost per foot....	12 65
Stoping on vein, 31 107-108 cubic fathoms, average cost per fathom.....	30 00
Stoping on amygdaloid, 1601 13-36 cubic fathoms, average cost per fathom..	16 23
Stoping on conglomerate, 238 31-36 cubic fathoms, average cost per fathom..	24 54

The total amount of ground broken in the drifts, shafts, stopes, etc., was 3,570 cubic fathoms.

The total number of tons of rock stamped was 20,549, which yielded 2 18-100 % of mineral. This includes only the stamp mill work.

The average yield of the mineral per fathom of ground broken was 537 pounds.

Stamp mill expenses were:

For labor.....	\$7,599 96
For 1,875 cords of wood.....	6,093 75
Lights, oil, shovels, etc.....	173 92
Repairs, fixtures, materials, etc.....	515 73

Total expense..... \$14,383 26

Cost of stamping and washing per ton, 61 35-100 cents; the running time of 24 heads was 134 41-72 days.

The number of tons of rock stamped per head per 24 hours of running time was 6 3-10 tons.

Number of tons of rock stamped per cord of wood consumed was 10 96-100 tons.

The cost per ton for breaking and selecting the rock, and for tramping it to mill was 10 24-100 cents.

The working force of miners was 145.

The average contract wages per month were \$51.34.

The average surface wages per month were \$42.12.

The average number of surface men employed was 35.

The average number of stamp mill men employed was 14.

The average monthly wages of stamp mill men was \$54.28.

Wheelers, laborers, timbermen, etc., working underground on company account, received in total for the year, \$27,613.31.

Total amount of surface expenses for the year 1881 was \$77,689.40. In this is included wages, hauling wood to fire holes, tramping, teaming to and from Eagle Harbor, freight, coal, timber, and all other expenses.



Construction account, including new compressor, building, and engine, drills, two new boilers in No. 2 engine house, labor, etc., etc., \$22,462.43.

Total of team expenses, \$1,991.75.

Total of underground labor, \$7,192.86.

Total gross expenses for the year 1881, \$216,062.01.

From which, deducting credits leaves a total of net expense of \$209,363.83.

Dividend paid of \$3 per share, \$60,000.

Total dividends paid to December 31st, 1881, \$1,664,000.

Total expenditures to December 31st, 1881, including dividends, paid, etc., \$7,141,711.08, all of which has been met by the sales of the copper produced.

The appearance of the vein at this date (March, 1882) is improving, and certainly looks, in the lower drifts, very promising, but the great masses which the mine has been wont to yield, and for the production of which it has so long been famous, have ceased to occur—a temporary suspension, let us hope.

The officers of the company are George A. Hoyt, President; John Stanton, Secretary and Treasurer, 76 Wall street, N. Y. Officers at the mine: James Dunstan, Agent; Samuel Bennett, Mining Captain; J. F. Robert, Clerk; Central Mine, Mich.

REPORT OF THE CENTRAL MINING COMPANY FOR THE YEAR 1881.

The directors present the following statement of the operations during the year 1881:

The production of mineral was 951 1445-2000 tons, and the quantity smelted was 978 1910-2000 tons, which yielded 72½ per cent, or 1,418,465 pounds of refined copper.

The following is a summary of the year's business:

PRODUCTION IN 1881.

Copper sold, 1,418,465 pounds @ 17 14-100 cents.....	\$243,194 15
Silver.....	1,109 62
	<hr/> \$244,303 77
Mineral at mine December 31, 1880 as, per last report, valued at.....	\$22,536 38
Mineral at mine December 31, 1881, 123 20-2000 tons, valued at.....	24,602 00
	<hr/>
Increase in value of mineral at mine.....	2,065 62
Net value of product of 1881.....	\$246,369 39
Add balance of interest account.....	3,266 53
	<hr/> \$249,635 92

COSTS.

Working expenses at mine.....	\$167,857 47
Smelting, freight, and all other expenses.....	34,158 39
	<hr/>
Net operating expenses.....	202,015 86
Showing a profit of.....	\$47,620 06
The surplus reported December 31, 1880, included 740,484 pounds copper, then unsold, valued at \$129,534 70, but which only realized \$117,569 39, the actual surplus December 31, 1880, being.....	343,079 14
	<hr/> \$390,699 20

DEDUCT.

Dividend February 25, 1881.....	\$60,000 00
Dividend August 1, 1881.....	60,000 00
Amount expended for power drilling machinery in 1881.....	22,462 43
	<hr/> 142,462 43
Making the net surplus December 31, 1881.....	\$248,236 77

As shown in detail in the annexed statement of assets and liabilities, and from which a dividend of \$2.50 per share (\$50,000) was paid February 4, 1882.

The production during the year was about 25 per cent (320 tons mineral) less than that of the previous year, but the amount of work performed has been larger in every department, except the cutting of mass copper, and particularly in the line of opening, or development work, which has been prosecuted with vigor in the expectation of meeting with more productive ground.

The report of our agent describes in detail the appearance and yield of the mine at the various points which have been worked, and it will be seen that the vein in the vicinity of No. 3 shaft—the locality of the “chimney” or “ore shoot” which has yielded so largely for some years past—has been comparatively thin and poor from the 19th to the 21st levels, and the “backs” over the 20th and 21st levels have produced very little heavy copper. The average yield of the ground broken during the year has declined to 386 pounds per fathom, from 596 pounds per fathom in 1880, which fully accounts for the reduced production for the year.

The bottom openings appear to be opening a larger and more promising vein, and those most familiar with the mine believe that although we have encountered an unusually “thin and poor streak,” the vein will expand again, and produce the heavy mass copper which has been characteristic of it.

A superior outfit of power drilling machinery has been provided, and was put in operation about the close of the year. Under the present conditions of labor, the introduction of this class of machinery has become a necessity, and its use will facilitate and cheapen the underground work, and enable us to open the mine with greater speed than heretofore.

For more detailed information we refer to the agent’s report, and the financial statements herewith submitted.

GEORGE A. HOYT,	JOHN J. CRANE,	ROBERT PORTERFIELD,
JORDAN L. MOTT,	WILLIAM C. STURGES,	A. J. HATCH,
NEW YORK, April 3, 1882.		<i>Directors.</i>

BALANCE SHEET CENTRAL MINING COMPANY, DECEMBER 31, 1881.

General expenditure to December 31, 1880..... \$5,168,229 44

EXPENDITURES IN 1881.

Central mine.....	\$196,814 87	
Freight.....	9,302 81	
Smelting.....	17,380 58	
Insurance.....	1,413 75	
Brokerage.....	912 18	
Expenses.....	5,149 07	\$230,973 26
Real estate.....		20,988 25
Dock and warehouse.....		9,112 07
Dividends.....		1,560,000 00
Cash.....		17,301 12
Loans on call.....		70,000 00
Copper bills.....		14,105 82
Copper on hand, sold (293,341 pounds).....		56,550 25
Silver on hand.....		1,109 62
Accounts receivable.....		442 84
		<hr/>
		\$7,148,812 67
Capital advanced by stockholders.....		100,000 00

# COMMISSIONER OF MINERAL STATISTICS.

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## SALES OF COPPER.

Sales previous to 1881.....	\$6,794,234 51	
Sales in 1881.....	243,194 15	
Silver.....	1,109 62	
		\$7,038,538 28
Interest received in 1881.....		3,266 53
Accounts payable.....		7,007 86
		<hr/> \$7,048,812 67

## STATEMENT OF ASSETS AND LIABILITIES, CENTRAL MINING COMPANY, DECEMBER 31, 1881.

### ASSETS.

<i>At Mine.</i>		
Mineral (123 020-2000 tons at \$200).....		\$24,602 00
Merchandise in store.....		43,703 26
Supplies.....		44,812 60
Cash.....		2,258 96
		<hr/> \$115,376 82

<i>In New York.</i>		
Cash.....	\$17,301 12	
Loans on call.....	70,000 00	
Copper bills.....	14,105 82	
Copper on hand, sold (293,341 pounds).....	56,550 25	
Silver.....	1,109 62	
Accounts receivable.....	442 84	
		<hr/> 159,509 65
		<hr/> \$274,886 47

Balance of assets.....	\$248,236 77
------------------------	--------------

### PERMANENT INVESTMENTS.

Mining plant, or implements, engines, stamps, houses, etc., valued at..	\$247,854 00
Real estate, being timber and other lands, not including mining loca- tion.....	20,988 25
Dock and warehouse at Eagle Harbor.....	9,112 07
	<hr/> \$277,054 22

### LIABILITIES.

Indebtedness at mine.....	\$15,089 40
Mine drafts.....	4,552 44
Accounts payable.....	7,007 86
Balance of assets.....	248,236 77
	<hr/> \$274,886 47

## AGENT'S REPORT.

CENTRAL MINE, KEWEENAW COUNTY, MICH., }  
January 1, 1882. }

*John Stanton, Esq., Secretary and Treasurer, New York.*

DEAR SIR—The following report is respectfully submitted for your con-  
sideration, and shows in detail the various expenditures for the year 1881 :

### GROUND BROKEN.

Sinking in shafts and winzes, 317 5-12 feet, average cost.....	\$29 81
Drifting on the vein, 1,695 3-12 feet, average cost.....	11 84
Drifting on the conglomerate, 83 3-12 feet, average cost.....	12 65
Stoping on the vein, 31 204-216 cubic fathoms, average cost.....	30 00
Stoping on the vein, 1,601 13-36 sup. fathoms.....	16 23
Stoping on the conglomerate, 238 31-36 sup. fathoms, average cost.....	24 54
The total amount of ground broken in openings and stopes is 3,570 fathoms.	

## PRODUCTION.

	Pounds.
668 barrels stamp copper, weighing.....	897,670
132 hogsheads kiln " ".....	415,015
163 masses " ".....	590,760
Total.....	1,903,445
Or 951 1445-2000 tons.	
Average yield of mineral per fathom of ground broken.....	533
Average yield of ingot per fathom of ground broken.....	386

## STAMP MILL.

The expenses at the mill were as follows:

Labor.....	\$7,599 96
One thousand eight hundred and seventy-five cords of wood consumed.....	6,093 75
Lights, oil, shovels, etc.....	173 82
Repairs, materials, fixtures, etc.....	515 73
	\$14,386 26
Tons of rock stamped.....	20,549
Yield of rock in mineral.....	2 18-100 per cent.
Yield of rock in ingot.....	1 58-100 per cent.
Cost of stamping and washing per ton.....	70 cents.
Running time of 24 heads.....	134 41-72 days.
Rock stamped per head in 24 hours running time.....	6 3-10 tons.
Rock stamped and washed per cord of wood consumed.....	10 96-100 tons.
Cost per ton of breaking and selecting rock and tramping it to mill.....	10 26-100 cents.

## WORKING FORCE.

The number of men in the different departments of work, and their average wages per month, has been as follows:

		Wages.
Miners.....	145	\$51 34
Surface men.....	35	42 12
Stamp men.....	14	54 28

The present force embraces 133 miners, 41 surface men and engineers, 14 stamp men and 8 mechanics, making with agent, clerks, and mining captain, 206 men employed by the company.

## SINKING.

No. 2 shaft has been sunk from the 21st level to the 22nd level. The skip-road and pump have been extended in this shaft from the 21st to the 22nd level, and we are now sinking to the 23d level. A winze has been sunk from the 21st to the 22nd level, just opposite No. 2 shaft. The vein in this winze was small and poor for the first 20 or 25 feet, then it commenced to improve in size and richness. About 40 feet under the 21st level the vein widened to about 5 feet in thickness, showing good stamp, barrel, and small masses of copper. There is a small mass of copper showing in the south end of the winze, with about one ton of it exposed. I am of the opinion that when we get the 22d level opened for stoping south of this winze, we shall find this a good block of copper ground.

No. 4 shaft has been sunk from the 20th to the 21st level. We are sinking an inclined winze on the south belt of conglomerate, under the 20th level. The belt at this point is 3 feet thick and well charged with stamp copper. This winze is also going down on the course of the vein, and has shown a better vein than we have seen in the north part of the mine for a number of years. I think it will give us a good block of stoping ground, which will be available as soon as the winze has reached the 21st level.



## DRIFTING.

The 19th level has been extended south of No. 2 shaft 207 6-12 feet. The vein was poor, but this level had to be driven to reach the south belt of amygdaloid, which was showing considerable copper in the 20th level.

The 20th level was driven south of No. 2 shaft 125 7-12 feet. The vein has been small and poor. The 21st level south of No. 2 shaft has been extended 204 3-12 feet. The vein has been very uniform throughout, carrying good stamp rock, but is only about 2 feet in thickness; the best portion of the vein, however, has been in the lower part of the drift, which leads us to think we are on the top of another "shoot" of copper, and that we shall find the vein larger and richer as we open the 22d level.

The 21st level has also been driven north of No. 2 shaft 432 3-12 feet through poor ground, and 157 11-12 feet north and 132 6-12 feet south of No. 4 shaft, the vein being small and poor. We have driven two cross-cuts from No. 2 shaft to the vein, one at the 21st level and the other at the 22d level.

No drifting has yet been done in the vein at the 22d level, but where the cross-cut passed through the vein it was about 4 feet thick, carrying good stamp and barrel copper.

## STOPING.

The stopes in the back of the 18th and 19th levels have produced most of the mass copper the past year, and we have a small block of good ground yet remaining in the back of the 19th level.

The stopes over the 20th and 21st levels have given us good stamp rock, but as the vein has been small they have not yielded a very large amount, and the falling off in the product of the year has been caused by the failure of these two backs to yield the usual quantity of heavy copper.

The south belt of conglomerate has been good at every point where work has been done on it. It is about 3 feet wide and carries rich stamp rock for about 25 to 30 feet where crossed by the vein, and then becomes poor.

We have done some stoping on a belt of amygdaloid at the extreme south end of the mine, which is generally supposed to be the "Osceola belt." It is about 20 feet wide. The copper occurs in bunches, and some of it is very good, but the greater part of the belt has been poor, so far however, we have not done sufficient work on it to prove its value.

## CONSTRUCTION.

During the past year we have built a stone building 48x48 feet with slate roof, for our new compressors, and have placed in No. 2 shaft about 2,000 feet of 6-inch pipe to convey compressed air to different parts of the mine, to operate the power drills. We are now working five power drills, and two underground engines to hoist rock from shafts and winzes, which will greatly lessen the general expenses, and enable us to open the mine much more rapidly than heretofore. The Rand Duplex Compressor and the power drills are working very satisfactorily.

We have added six copper washing machines to the stamp mill, besides several other minor improvements. All the machinery, both on surface and underground, is in good condition, with the exception of the foundation of the stamp mill engine, which will have to be replaced next summer.

Respectfully,

JAMES DUNSTAN, *Agent*.

## STATEMENT of Production, Cost, and Results from Central Mine, 1874 to 1881 Inclusive.

CENTRAL MINING COMPANY.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.
Product of stamp copper.....	1,270,503 lbs.	1,294,340 lbs.	1,298,242 lbs.	1,188,242 lbs.	1,011,750 lbs.	829,205 lbs.	899,977 lbs.	897,670 lbs.
Product of kiln copper.....	381,349 "	381,160 "	538,723 "	568,491 "	641,279 "	635,510 "	387,682 "	415,015 "
Product of mass copper.....	812,000 "	731,937 "	969,218 "	1,120,129 "	1,064,053 "	1,038,497 "	1,954,901 "	590,760 "
Total product, mineral.....	2,480,860 "	2,407,437 "	2,806,183 "	2,816,862 "	2,717,112 "	2,323,042 "	5,543,590 "	1,903,455 "
Product of ingot copper.....	1,740,603 "	1,466,952 "	2,161,400 "	1,396,669 "	1,891,013 "	1,789,415 "	2,026,078 "	1,418,465 "
Percentage of mineral.....	72.45	70.82	71.22	71.39	71.1	75.	70.6	72.5
Gross earnings.....	\$366,208	\$373,634	\$425,095	\$368,044	\$301,212	\$388,914	\$363,935	\$263,663
Total expenses.....	257,958	233,245	280,060	263,347	212,335	200,890	240,102	262,093
Per cent of expenses to earnings.....	70.44	62.42	65.89	71.43	70.51	69.53	66.4	80.92
Net profit.....	\$108,250	\$140,389	\$144,966	\$105,297	\$88,877	\$88,023	\$123,874	\$101,570
Dividends paid.....	160,000	80,000	100,000	140,000	100,000	80,000	100,000	180,000
Surplus undivided.....	308,987 99	\$322,087 03	367,053 03	332,350 04	318,878 82	332,220 39	355,064 45	\$1 248,286 77
Total mining cost of ingot copper per pound.....	11.58 cts.	12.32 cts.	9.84 cts.	10.27 cts.	8.71 cts.	8.97 cts.	9.35 cts.	11.53 cts.
Smelting, marketing and other expenses per lb.....	3.24 "	3.49 "	3.11 "	2.92 "	2.32 "	2.19 "	2.30 "	2.41 "
Average cost per pound, marketed.....	14.82 "	15.81 "	12.95 "	13.19 "	11.23 "	11.16 "	11.85 "	14.24 "
Average sales of ingot copper per lb.....	20.81 "	22.56 "	20.86 "	18.36 "	15.84 "	15% "	18.86 "	17.14 "
Tons of rock stamped.....	15,368	17,118	12,658	14,119	13,838	12,478	14,520	20,549
Average per cent of mineral in stamp rock.....	3.85	3.78	5.13	4.21	3.65	3.32	3.09	2.18
Stamp mill in operation.....	94 3/4 days.	91 days.	97 1/2 days.	108 days.	106 days.	90 days.	123 days.	134 days.
Cost per ton stamping and washing.....	\$1 07	86.76 cts.	\$1 02	\$2.61 cts.	69.70 cts.	64.27 cts.	72.25 cts.	70 cts.
No. of fathoms broken in openings and stopes.....	2,636	3,226	3,251	3,269	2,712	2,537	3,367	3,576
Yield of mineral, per fathom.....	910 lbs.	746 lbs.	863 lbs.	862 lbs.	1,001 lbs.	915 lbs.	778 lbs.	533 lbs.
Yield of ingot copper per fathom.....	660 "	528 "	614 "	615 "	711 "	686 "	596 "	386 "
Average force employed.....	515 men.	212 men.	324 men.	242 men.	220 men.	211 men.	224 men.	194 men.
Average number of miners.....	161	158	184	135	175	168	179	145
Average wages of miners, per month.....	* \$33 14	\$32 65	\$51 39	\$49 80	\$45 67	\$17 05	\$36 71	\$51 34

\* There was a decrease in the rate of wages per man in 1874, of miners, 18 per cent; of surface men, 14 per cent; and of stamp men, 12 per cent.

† Of which was expended for building and construction \$48,289, leaving a net gain in 1875 of \$92,099.

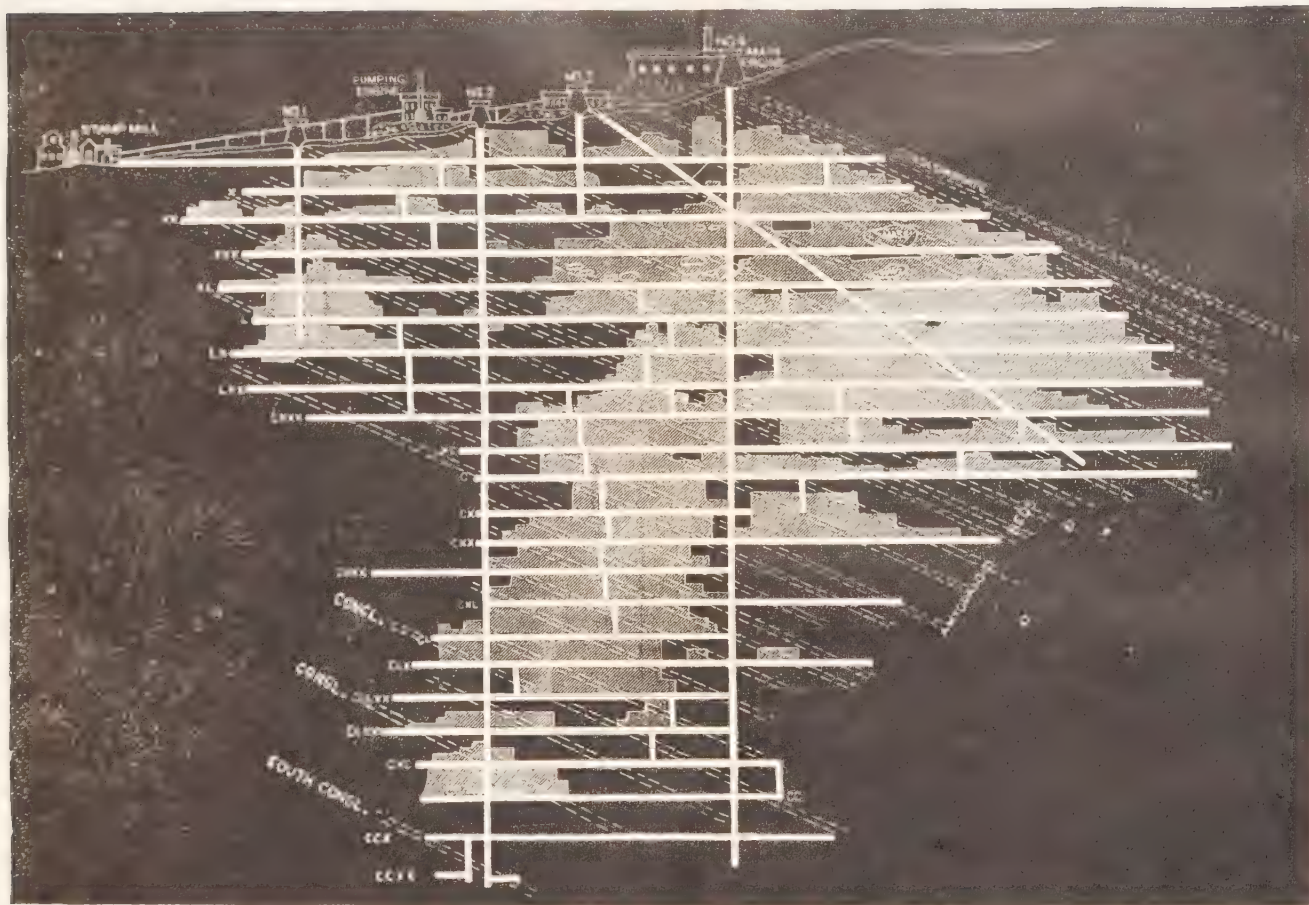
‡ Of which was paid for woodlands, \$5,848.71, making net gain for year, \$82,968.78.

§ To which add \$3,114 realized on a claim charged off in 1876 as not collectible, and \$5,763 75, amount received on account of redemption of Madison lands making the net gain in 1879, \$96,901 57.

¶ From which dividend of \$50,000 was paid February 4, 1882.

VERTICAL SECTION OF THE CENTRAL MINE, 1883.

Scale, 360 ft. to one inch.







## THE COPPER FALLS MINE.

The Copper Falls Mine does not seem to have been remarkably prosperous during the year. The outlook just now, however, is more favorable, owing to the occurrence of considerable mass copper in the fissure vein—Owl Creek vein—the old mine from which the ash bed is worked.

The main dependence of the Copper Falls Mine is the ash bed, but the ash bed lies very flat, having an inclination with the horizon of only 27° or 28°, and it is very lean, affording in favorable portions of it only 20 pounds of copper to the ton of the rock. If this were an average of the yield of the belt it could be worked at a profit, as is shown by the results achieved at the Atlantic Mine; but the ash bed, unlike the Atlantic lode, has great stretches of worthless ground, necessitating the opening of extensive drifts in order to even reach the moderately productive portions of the lode, and then the flatness of the bed renders necessary the shoveling of the rock over, down the foot wall to the drift.

At the beginning of the year but few miners were employed. The mine was well opened and considerable stamp rock had accumulated in the mine. In February, 1881, the number of miners was increased to 46 men; in March to 58, the total force then being 202 men. In July the number of miners was 38, and the total force was 182 men, of whom 21 were underground laborers—men passing rock, 19; trammers, 6; fillers, 7.

	Men.
In September the number of miners was.....	63
In October " " " " ".....	52
In November " " " " ".....	41

Also 16 underground laborers, 8 passing rock; 9 trammers, 3 fillers. The average for 12 months is 50 miners employed.

The mill is furnished with two Ball stamp heads, both of which were run up to the 6th of October last, since which only one has been operated. The highest number of tons of rock were stamped in April—5,250 tons—which gave a product of 52 tons, 1,530 pounds of mineral.

In June 5,100 tons were stamped, which yielded 50 tons 1,025 pounds of mineral.

The total number of tons of rock stamped during the year 1881 was 55,187 tons, which yielded 459 tons 310 pounds of mineral.

About 10 or 11 tons of the product was mass and barrel work, and the remainder was stamp work from the ash bed. It will be seen that the yield is less than one per cent of copper.

The expenditures for the year to December 31, 1881, were \$171,878.48.

The addition to the mining plant for the year, which may be reckoned as permanent improvement, was \$23,066.93, which sum, taken from the total expenditure, gives the cost of mining work, or what was really expended to produce the copper.

Total expenditure.....	\$171,878 58
Permanent improvement.....	23,066 93
Leaving.....	\$148,811 55
Total expenditures of company to December 31st, 1881.....	\$2,550,668 21
Miners, working hand drills, received per month.....	\$45 00
" " Rand " " " " ".....	50 00
Trammers received per month, average.....	37 11

Laborers on surface received per month.....	\$35 to \$40
Underground laborers received per month.....	37 27
Miners passing rock.....	35 81
Miners filling cars, etc.....	39 68
Timbermen.....	48 00

They worked from three to nine power drills constantly.

The average cost per foot for sinking with power drills.....	\$10 86
The average cost per foot for drifting with power drills.....	9 08
The average cost per fathom for stoping.....	13 99
The cost per foot for drilling holes.....	14 <sup>3</sup> / <sub>4</sub>

This price varies with the size of the hole.

#### HAND DRILL WORK.

Total cost per foot for sinking shafts, etc.....	\$11 65
Total cost per foot for drifting.....	10 33
Total cost per fathom for stoping ground.....	14 00

The rock is all run out of the long adit in trains of five cars, each train drawn by one mule. They are now, with one Ball head, stamping 150 tons of rock per day.

They are working 87 men in the mine now, and are 84 feet below the main adit and drifting north; below the adit they are only working in the ash bed. The old shafts below the adit being full of water, in the ash bed the mine makes but little water, and what there is drains out of the adit. The mine is down to the one hundred and tenth level, but the recent find of rich copper ground, in the fissure where it crosses the ash bed, is at a point only 85 feet below the adit, and 480 feet north of Spencershaft. The adit is the 90-fathom level, and they are working below in the one hundred and tenth to find if the "rich shoot" continues down. The vein here widens out to 12 feet, and one mass now fully out is 10 feet in length, and will weigh several tons. They are also working in the ash bed 800 feet west of Spencer shaft. The west 200 feet of this drift is looking poor.

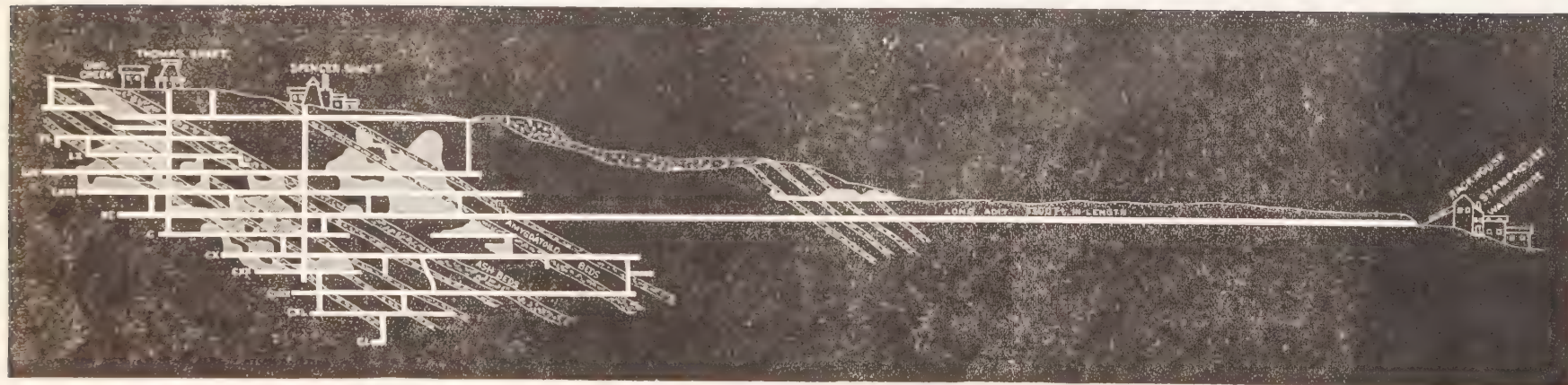
In about 200 feet further the drift will cut the Lower Falls vein, the first vein that was worked on the property, a mine having been started here in 1845, and considerable work was done, one of the four shafts that were sunk reaching to the depth of 208 feet. The vein was irregular, but bore tolerably well in places. The working was done in a trap bed, which was overlaid by and also rested upon sandstone. The vein was found to be split up and barren in the sandstone, underlying the trap, and after passing through the sandstone and reaching the trap bed, which succeeds it, the vein appeared to be lost, and some cross-cutting was done to recover it, but without success. The vein, however, was subsequently found on the surface, crossing the underlying bed. It is probable that the company will continue the drift until it intersects this vein. In this drift they also expect to cut the Dribble vein, which has been traced on the surface but has never been worked.

The number of shares is 20,000, which in 1877 were increased in value to \$50 each, making the capital stock \$1,000,000. The officers have issued a call for a meeting of the stockholders to increase the number of shares to 40,000, probably making them \$25 each, leaving the capital stock as it is. This will make the number of shares and the value of each correspond with those of most other companies.

The officers are: David Nevins, Jr., President; John Brooks, Secretary and Treasurer, Boston, Mass. B. F. Emerson, Agent, Copper Falls, Mich.; Wm.

# LONGITUDINAL SECTION OF THE COPPER FALLS MINE, 1881.

Scale, 500 ft. to one inch.







Jacka, Mining Captain, Copper Falls, Mich.; D. W. Twoly, Assistant Clerk, Copper Falls, Mich.

#### THE ASH BED MINING COMPANY.

The treating of the ash bed rock by the machinery now in operation at the Ash Bed Company's mill is an important departure from the ordinary stamps, etc. The method at the Ash Bed consists simply of a system of breakers, rollers, jigs, and grinders manufactured by Samuel Hodge, Riverside Works, Detroit.

From the breaker the rock is passed between a pair of iron rollers that crush it to the size of 3-16 of an inch. Thence it passes over a pair of jigs, thence to a sifter, that has a lateral motion; the jig takes out all the fine portions and the coarser pass to the sieves, and thence to a second set of rolls, which reduce the lumps to the size of a quarter of an inch. The jigs operate in water as at other mills, and separate the lumps of copper.

From the second pair of rollers the product passes in succession to two sets of jigs, four in all, each 4 feet by 2 feet 6 inches, and thence to automatic sifters, working laterally as a fanning mill sieve. The sand passing through the sieves is ground with the material that passes over the sieves, the latter being first ground by itself, and the two coming together pass through a Hodge grinder, which consists of the frustum of a cone revolving in a sheath of the same form, working to a degree of closeness sufficient to secure the requisite fineness to the sand. The revolving and the stationary surfaces are also properly grooved, as in the manner of grinding surfaces. The jigs are made a foot longer than ordinary to give the sand more time to settle. No trouble is experienced by copper clinging to the rollers; a stationary scraper removes all adhering particles. After passing through the grinder a succession of jigs completes the separation.

The machinery has been in operation since June 1. The old stamp mill was burned the last day of April and a new one erected on the same site, was completed and got into operation June 1st. No slime tables are used; none are needed, as by this method the making of slime is avoided.

The yield of copper has been 98-100 % ingot. The product is all trammed out of the adit, which is 1,350 feet in length, and the stamp mill is distant from the mouth of this adit about 208 feet to the north.

The adit cuts three prominent parallel lodes, the lower of which is the best; they are 10 feet to 12 feet apart. The adit goes in on a narrow fissure vein that yielded little or no copper; in the mine the vein splits into two branches, and an adit runs in on each. The adit is about 150 feet vertically below the outcrop of the ash bed, and 300 feet below, on the lay of the bed. The water is supplied from a dam, and is brought in a launder to the mill. But little work has been done on the deep adit that is designed to reach the lake shore. In the mine about one half of the ground that is opened is left standing, as it is too poor to stope; but the poor ground, as does the productive, occurs in bodies by itself, so that there is no trouble in selecting. The purpose of the company is to test the ash bed and find out, if possible, how much can be got out of it, and the cheapest way to get it. Ball's stamps pound up the rock too fine. Much of the copper, if it could be separated of the size in which it occurs in the bed, is in sufficiently large pieces, but the stamps reduce it to small particles, and then the trouble is to separate them from the sand. The

stamps make all fine copper where but little naturally exists, and it is difficult to save it. Ball stamps, on the ash bed, make 25 % of slime in addition to the fine particles which they make that are separated by the jiggers. It is certain that some method better than stamp can be devised for the ash bed, and possibly the method now being tried at this company's mill, or a modification of it, will accomplish what is desired.

The company works about 25 men, running only day shift. The mill works up 25 tons per day, of rock, and it costs \$2.75 per ton to mine and treat the rock. Mr. Delano, the agent, hopes to reduce the cost to \$2.50 per ton. This result could, undoubtedly, be reached if a compressor and power drills were used.

The deep adit has been, in former years, driven in about 500 feet, but the present company does not contemplate continuing the work here on this vein, but to transfer it to the west vein, which is three-fourths of a mile to the west of the present mine.

A mine here was opened twenty years ago by four adits driven in at different heights in the vein, the lower one being but a little above the lake.

The main reason for selecting this vein in preference to the one now worked is that it comes a mile nearer the lake shore, or rather that the lake, because of a bay or curve in the shore line, comes a mile nearer the mouth of the adit at the west vein than it comes to the present mine, and as the intention is to place the mill on the lake shore, the matter of distance becomes important; other things being equal, nearness to the lake must naturally govern the choice; but the company has not fully decided upon any definite course, and in this they evince wisdom; better make haste slowly, fully test all the new methods, and find in this way, if possible, how the ash bed may be worked to a profit before incurring an enormous expenditure upon an uncertainty and end up finally, after a few years' trial, in disastrous failure.

The ash bed at the Petherick, the former name of the mine, is as good as at any point at which it has been opened, and now at the beginning of the career of the new company, it may as well work out a solution to the problem of how best to operate the great deposit.

The company has obtained  $19\frac{1}{2}$  pounds of ingot to the ton of rock, which at 17 cents per pound would give \$3 33 per ton, and if the cost of mining and separating etc., can be reduced to \$2.50 per ton there would be a profit of 83 cents per ton; but anyhow, if 500 or 600 tons per day can be regularly mined and treated, which shall yield 98-100 % ingot copper, the work can be done at a profit.

The total product of mineral for the year has been 25,310 pounds. The output was greatly cut short by reason of the burning of the stamp mill. The company has no indebtedness. The total expenditures for the year have been \$39,090.99.

The construction expenses were \$31,212.02, which latter includes getting ready to resume work, etc., at the beginning of the year.

The mine adjoins the Copper Falls, lying next west from it. The property originally constituted a portion of the Copper Falls estate, having been set off from it in 1861 to organize the Petherick. The present company, under the name of Ash Bed Mining Company, was organized in 1877.

The capital stock is \$1,000,000, divided into 40,000 shares. There are about twenty dwellings on the location, and some other buildings. The company's estate consists of 1,100 acres of land in sections 2, 10, 11, 14, 15, and 23, T. 58 N., R. 31 W.

The officers are Wm. P. Hunt, President; W. C. Coffin, Secretary and Treasurer, Boston, Mass. M. A. Delano, Agent, Phoenix Mine, Mich.

#### THE ST. CLAIR COPPER COMPANY.

The St. Clair Copper Company continues work, but with no very encouraging outlook. The mine is in a fissure vein, south of the greenstone and east of the Phoenix. The main shaft is down 390 feet, vertically, below the surface, to the fourth level, the shaft at the bottom being 1,010 feet south from the greenstone. The mine is crossed by a "false slide," which in the fourth level is 375 feet south from the greenstone, and in the first level it is 145 feet to the south, thus dipping at an angle of about 45°, while the formation dips at 28°.

The best copper ground is between the false slide and the greenstone, though some stoping is now being done south of the slide. The vein is a narrow one, but otherwise looks well.

The plan now is to sink from the 40-fathom level an inclined shaft on the "slide," and to hoist by means of a small engine placed underground to this level, and tram thence along it to the shaft, and thence up to the surface. The product is mostly in small masses, from a few pounds to a thousand pounds' weight—mainly of a size to constitute barrel work. The product of the year to December 31st, 1881, was 121,393 pounds of refined copper. What little stamp rock is obtained is very rich, yielding 4 % to 5 % of copper.

The rock house and stamp mill are nearly new, having been rebuilt after the fire, which consumed the former ones in the fall of 1880. The mill is now idle, undergoing repairs. It contains 12 heads of Gates's stamps. The total expenses for the year were \$21,133.73; the construction account amounted to \$5,000. The number of men employed is about 25.

No indebtedness has been incurred, as the product has sufficed to meet the outgoes; in fact the expenses have been kept within the income. The expenses run about \$1,800 per month.

The estate consists of 133 acres on Sec. 29, T. 58, R. 31. The stock is largely held by Lake Superior men. The officers are John Brooks, Secretary and Treasurer, Boston, Mass. M. A. Delano, Agent, Phoenix, Mich.

The capital stock is \$1,000,000, divided into 40,000 shares.

#### THE OLD PHOENIX.

The Old Phoenix Mine is just now attracting a good deal of attention from the fact that there has been recently exposed in the bottom of the mine, in the 150-fathom level, what seems to be an immense mass of copper. This mass forms the entire west wall of the drift for a distance of nearly 40 feet, leading north, and commencing but a short distance from the foot of the incline shaft. The mass extends below the bottom of the drift and above the top, to what distance is not known; neither has it yet been determined as to how far it extends to the west, into the wall by the drift; but struck with the hammer it has a solid ring, and is, apparently, an enormous boulder of pure native copper of, possibly, several hundred tons weight, though of course it may prove to be a mere slab of metal—instead of having 6 feet or 8 feet of thickness, may prove to be only as many inches.

The Phoenix was noted, in former years, for its yield of great masses. The



mine once afforded a mass of 600 tons weight, so that it is not an unreasonable conjecture that a like fortune may again award the owners, who have so long and patiently labored and waited for a return that their faith has well deserved.

Heretofore in the Phoenix the occurrence of a great mass has usually been followed by a succession of them, and this fact adds to the interest with which the new find is regarded.

For several years the Phoenix has scarcely held her own; but in past years the mine has yielded a great deal of copper, sufficient, at times, to place the affairs of the company in a very prosperous condition. At present the outlook of the mine is favorable. In addition to the mass above described, the vein in the lower levels, and at the south end of the same drift in which the mass is found, has a "healthy," "promising look."

The mine is down to the 150-fathom level, and as far down as the 120th level, it is worked up to the greenstone under which the mine extends. Two lifts have been sunk within the past year, and the 140th level has been driven 760 feet south from the inclined shaft, commencing at a point 150 feet south of this shaft; for the rest of the distance to the breast of the drift two-thirds of the ground has been stoped away. From this level, near the incline, a winze has been sunk to the 150th, and from it a drift has been extended south 175 feet, and north 200 feet, passing the incline and going 75 feet beyond. This winze was sunk in remarkably good copper ground. The incline is the main working shaft and it is a fine one, heavily and handsomely timbered, and straight as an arrow. It extends down into the mine a length of 2,100 feet, and is laid with T rail, nearly perfect in alignment and smoothness. The bottom of this shaft is about 1,200 feet vertically below the surface. At the time of my visit to the bottom of the mine the men were engaged in placing timbers across the drift at the top, commencing above the foot of the incline, for the purpose of forming a floor from which to begin to take out the back of the drift to the north and above the copper mass. The timbering in the Phoenix mine is exceedingly well done. It would seem incredible to a novice, that great logs 3 feet in diameter and 18 feet to 25 feet in length, can be taken down under ground 1,200 feet, and then moved to the required spot and hoisted to a height of 12 or 15 feet above the bottom of the drift, and put in place, one after the other—horizontally or inclined—to form a floor or a roof, and laid with as much regularity as the joice or the rafters in a building.

In one respect the copper mass is conveniently placed. It is close to the shaft and therefore may readily be transferred to the skip and hoisted to the surface; but, on the other hand, working it out will greatly widen the opening and render it very difficult to timber the shaft as it is carried downward. The shaft, preserving its straight course, is sometimes upon one side of the vein and sometimes upon the other, and, again, as it now is, at the bottom, directly in the vein.

This shaft was a good piece of mining engineering. It was built in sections under the direction of the engineer, Mr. L. E. Emerson, and when the separate portions were driven to connect, they were found to be exactly in line. Lights placed at the center plumbs were exactly in line from the top to the bottom of the shaft. The gauge of the track in the shaft is 4 feet 8½ inches.

On the east side of the shaft, stairs extend from the surface to the bottom of the mine, and along the upright timbers which separate this passage way







from the railway track, is now being fastened the pipes connecting with the compressor, which is to convey the air down into the mine for operating the power drills. In the 130-fathom level, on the east side of the shaft the air receiver—30 feet in length—is placed.

The product for 1881 is 301 tons of mineral. The average number of men employed was 120, of whom 65 were miners. The company is now putting in a compressor, temporarily, one borrowed from the Copper Falls Mine, which in time will be replaced by one of its own, now being made. The one now in will serve to operate five power drills, and these will soon be at work. Heretofore the drilling has all been hand work.

The average wages paid to miners was \$47 per month; the average wages paid to underground workmen, other than miners, was \$45 per month; surface men received \$35 to \$40 per month: miners pay for board, etc., \$16 to \$18 per month. Bituminous coal at the mine costs, per ton, \$6. Assessments made in 1881, \$1 per share.

In the old mine, north of the Greenstone, the company has kept a party of men at work during the year driving up on the deep adit, which starts from a point 90 feet above the lake, and is opened south on a fissure vein. The mine is called the B shaft. The vein is poor and affords very little copper, so that the driving of the adit is practically dead work. It is now in 2,820 feet from the mouth. The south end of the drift is about 150 feet vertically below the surface. No ultimate plan regarding this mine has been decided upon. The adit will be continued to the ash bed, or to intersect with the B shaft, which is sunk in the ash bed, and if the outlook is sufficiently favorable a stamp mill will be built on the Lake Shore and preparations made for working up a large amount of the ash bed rock. The distance from the mouth of the adit to the lake is one-half mile.

No company has met with greater reason for discouragement, and shown more faith in overcoming them, in its past history, than the Phoenix. With the exception of the Pittsburg and Boston it was the first company organized to work on the lake, and began practical mining as early as 1844, and has ever since worked continuously upon the original location. Not unfrequently its affairs have been at the lowest ebb and ruin seemed inevitable. Yet the crisis has been met, the funds contributed, the company again set upon its feet and started anew to arrive finally at a like termination. Its history is made up of fresh starts and renewed failures, and instead of the patiently waited for dividend the much enduring stockholder has been regularly called upon for a contribution. Whenever the mine has proved largely productive, and a surplus has accumulated in the treasury, the Robbins vein, or some other worthless receptacle, has absorbed the revenue and the stockholders had only to congratulate themselves upon a brief respite from the accustomed assessment. If their pockets were not replenished, for a brief period, they were not depleted.

The statement which has so frequently been made by the officers of the company, that "the property is a valuable one," is unquestionably true, and it is to be hoped that the stockholders may yet realize a practical verification of this statement, and be speedily rewarded for their patience and faith, by "finds" of the metallic richness for which search has long been made.

The company's estate lies in Sections 19, 20, 29, and 30, T. 58, R. 31, and comprises 2,477 acres of land. The principal mine—the old Bay State vein—is on the S. E.  $\frac{1}{4}$  of Sec. 30. The officers of the company are Wm. P. Hunt,

President; W. C. Coffin, Secretary and Treasurer; office, Boston, Mass. M. A. Delano, Agent. Richard Bawden, Mining Captain, Phoenix, Mich.

The number of shares is 40,000; par value, \$25 per share.

The following table shows the amount of sinking, drifting, and stoping done in the mine for each month during the year, and the monthly cost.

1881.	Feet of Sinking.	Cost.	No. of feet Drifting.	Cost.	No. of fathoms stoped.	Cost.
January.....	-----	-----	57 7-10	\$643 30	112 1-5	\$1,012 08
February.....	-----	-----	50 1-10	638 70	93 7-10	1,175 73
March.....	-----	-----	73	906 50	86 6-8	1,177 42
April.....	41.	\$860 00	-----	-----	93.88	1,284 09
May.....	35	788 00	6 7-10	53 60	53.83	735 88
June.....	43 2-10	900 20	11 6-10	92 80	109.77	1,532 57
July.....	36 9-10	799 30	18 9-10	158 10	85.22	1,298 47
August.....	16 3-10	577 50	52 1-10	353 60	63.42	897 09
September.....	16 7-10	584 50	77 2-10	524 00	78.79	1,214 45
October.....	27	945 00	85 9-10	585 90	103 2-10	1,687 76
November.....	14 3-10	545 50	62 6-10	516 70	103 1-25	2,085 99
December.....	16 6-10	415 00	60 6-10	596 65	87.81	1,755 18

#### CLIFF MINE.

At the old Cliff Mine little work of importance has been done during the year. The agent, Mr. O. A. Farwell, died June 22, 1881, and has been succeeded in office by Mr. D. D. Brockway. Mr. Farwell had resided in the copper region for many years—as Agent and President of the Phoenix, and then agent of the Cliff, and was widely known and much esteemed.

The mine is kept free from water, and some men are now working in the 80-fathom level, drifting east and west from the vein in No. 9 amygdaloid. It will be remembered by those who are familiar with the mine and with its past history, that these amygdaloid “floors,” especially the one above referred to proved productive, and the working of it in some of the drifts resulted profitably.

The formation south of the greenstone is made up, in part, by these amygdaloid belts which sometimes have been found, near the vein, to carry copper in considerable quantity, but any extensive working of them has never resulted favorably. In the Cliff these beds were numbered in the order of their occurrence from the greenstone, and No. 9 was found to carry the greatest proportion of copper of any of the belts crossed by the vein in the mine. The company at the present time is exploring this belt. In the 80-fathom level the men have drifted east and west from the vein about 20 feet. They are working here two power drills, operated with a Rand compressor, which was put in last October.

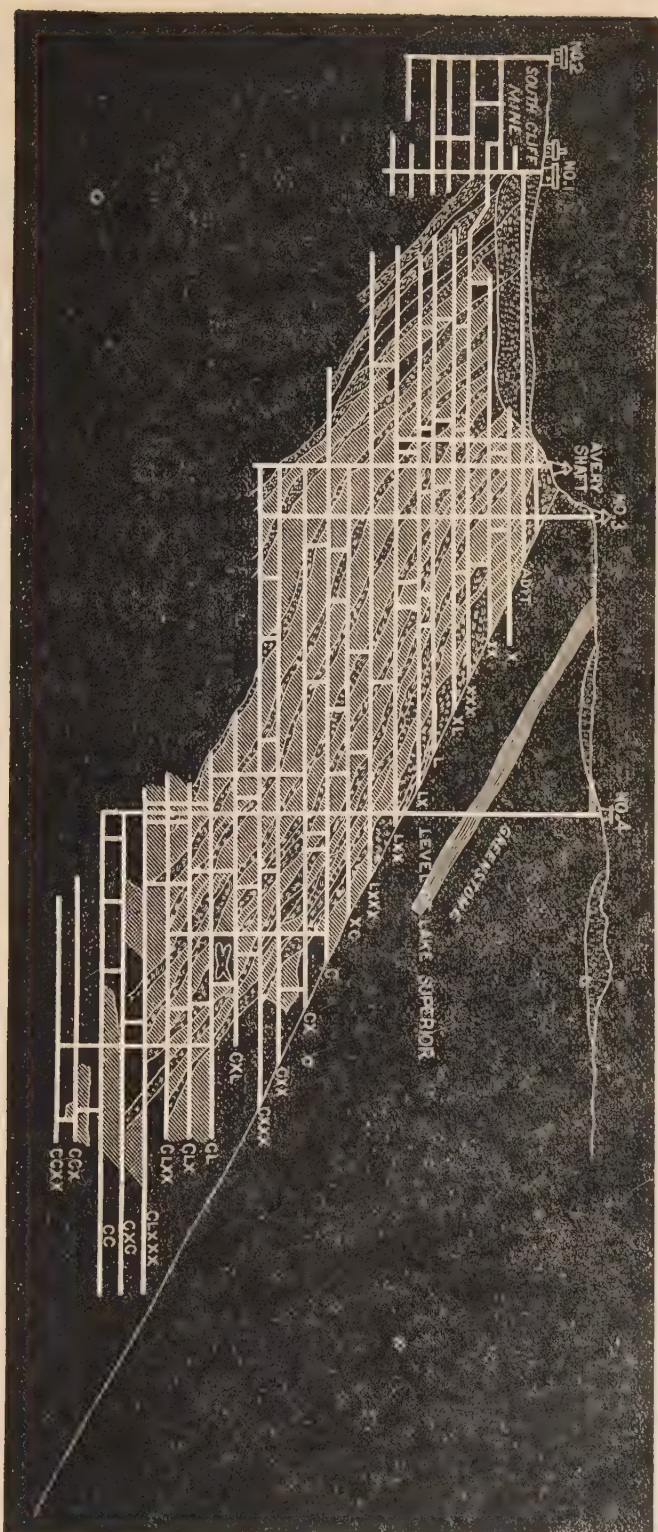
In the 140-fathom level a few men are working a stope, 140 feet south from No. 4 shaft. It is the intention to push north to the greenstone in the lower levels and thus explore the large area of unknown territory, which lies in this direction. In the 200-fathom level the drift already extends to the north a distance of 1,300 feet from No. 4 shaft.

The management also contemplates sinking a shaft 300 feet south from the greenstone, and to carry it down to the bottom. Such a shaft, after reaching



# LONGITUDINAL SECTION OF THE CLIFF MINE, 1881.

Scale, 600 ft. to one inch.





the 80th level, would pass thence entirely through unexplored ground, and would possibly open a mine that would prove productive, lying between the North American or South Cliff, and the Old Cliff Mine.

Still one would think it were a cheaper and equally effective way to accomplish what is desired, to refit the old Avery shaft which, it will be remembered, is just south of the greenstone bluff, and goes down vertically to the 130th level, but below the 80th the drifts have not been extended to the south at all, except the 100th. In former times this ground was not thought to be productive, but it has never been tested to any great depth, and thus may, on further investigation, prove to be a valuable portion of the lode.

The company has continued the work on the ash bed, begun the previous year. Three shafts have been sunk about 100 feet deep. No. 2 is 700 feet east from No. 1 shaft, and No. 3 is 650 feet east from No. 2.

The Cliff is the oldest mine on Lake Superior, and once the most important one. It returned in dividends 2,000 % on all the money that the stockholders were called upon to advance, and was sold to the present owner, Mr. M. H. Simpson, of New York, for the sum of \$100,000 in 1871. Since the stopping of work in 1870 by the old company, comparatively little has been done.

The mine is in a transverse fissure vein, which crosses the formation at nearly right angles. The mine lies south of the greenstone and is the only one that has a shaft down through the greenstone from the top of the range. This shaft is the one now used in hoisting.

The capital stock is \$1,000,000, divided into 40,000 shares. D. D. Brockway, Agent, Clifton, Mich.; J. C. Trembath, Clerk, Clifton, Mich.

#### THE SENECA MINING COMPANY.

The Seneca Mining Company owns a large estate, lying in the range of the prominent lodes that have been successfully worked to the south, and the property is undoubtedly crossed by them; but unfortunately the formation is so deeply covered with drift, and withal the soil is so swampy that exploration is difficult and expensive. The property comprises Sec. 21, N.  $\frac{1}{2}$  and N. W.  $\frac{1}{4}$ , and N. W.  $\frac{1}{4}$  S. E.  $\frac{1}{4}$  of Sec. 22, and N. W.  $\frac{1}{4}$  Sec. 23, and N.  $\frac{1}{2}$  and S. W.  $\frac{1}{4}$  Sec. 28, and E.  $\frac{1}{2}$  Sec. 20, and E.  $\frac{1}{2}$  Sec. 29, and E.  $\frac{1}{2}$  Sec. 32, and S. E.  $\frac{1}{4}$  of S. W.  $\frac{1}{4}$  Sec. 32, all in T. 57, R. 32.

Many years ago some mining work was done on the property in the Kearsage conglomerate, and the work was abandoned. This work was on the N. E.  $\frac{1}{4}$  of Sec. 32, and in 1880 it was deemed best by the present owners of the property to undertake further exploration. The location where this mining work is being prosecuted is now known as the Ahmeek.

A shaft has been sunk in the foot wall at a short distance from the old shaft, and been carried down to the fourth level, and in the second level a cross-cut has been made through the lode to the hanging wall, 70 feet horizontally, the lode being about 50 feet wide. A second shaft, No. 2, has been sunk 400 feet north from No. 1, and the two have been connected by a drift at the second level. In the first level no work has been done except to drift to the hanging wall and to connect with the old workings.

In the third level the only work done consists in cutting out a safety chamber for the men to resort to, to escape from the blasts.

In the 4th level a short drift has been made from No. 2 shaft.

The plant consists of a hoisting engine, used to hoist from both shafts; a pumping engine, and a Clayton compressor running four power drills.

Test pits have been sunk on the property in the Kearsage amygdaloid at a distance of 1,130 feet east from the mine. These pits are 50 feet deep through soil and quicksand; the ground being so wet it is found to be difficult to test the lode in this way, since, when the rock is reached, the blasts knock out the timbers and so let in the quicksand and dirt and fill the shafts.

It is contemplated to cross-cut from the mine to the amygdaloid, through the intervening rock, and thus obviate the difficulties arising from insecurity of the soil, and prove the ground. A few years ago this would have been a serious undertaking, but now, with power drills and high explosives, it is comparatively a simple matter; when the inducement is sufficient the length of the drift is of little consequence. The work thus far is for the purpose of exploration. No stoping has been done and no copper has been shipped, and it is not yet known whether the Ahmeek will become a mine or not.

The work is in charge of Capt. Daniels, the Agent of the Osceola. The business office is in Boston. J. W. Clark, President; A. F. Bigelow, Secretary and Treasurer.

The capital stock is \$1,000,000, divided into 40,000 shares.

#### THE KEARSARGE MINING COMPANY.

The Kearsarge Mining Company owns the S.  $\frac{1}{2}$  of Sec. 6, and S. W.  $\frac{1}{4}$  Sec. 5, T. 56, R. 32, and the E.  $\frac{1}{2}$ , S. E.  $\frac{1}{4}$  of Sec. 1, T. 56, R. 32, making a rectangle one and three-fourths miles east and west, and one-half of a mile north and south, comprising 460 acres of land.

The property is crossed by the several prominent lodes of this region, and adjoins on the north the now celebrated Wolverine Mine, and has upwards of 3,000 feet of extent of the lode which, just at present, is proving so wonderfully productive in copper.

If the Wolverine continues to open favorably the management of the Kearsarge will also commence work, and will open on the same lode—the Kearsarge amygdaloid.

They now have the matter under consideration, and it is likely that at least test pits will soon be sunk to uncover the lode. The capital stock is \$500,000, divided into 20,000 shares. The business office is in Boston. Joseph W. Clark, President; A. S. Bigelow, Secretary and Treasurer.

The local affairs of the company are in charge of Capt. John Daniels, Agent of the Osceola.

#### THE WOLVERINE MINE.

No recent discovery in the copper region has attracted so much interest as does the so-called Wolverine Mine. The openings thus far made are showing so phenomenally rich that great curiosity is excited to see how long this extraordinary yield of copper will continue.

Two shafts have been begun, about 300 feet apart, and are only down about 40 feet from the surface, and already the shipment of copper has begun to the smelting works, enough having been obtained to more than repay all the expenditure that has been incurred, including a small hoisting engine and a compressor.



The property consists of the N.  $\frac{1}{2}$  of the S. E.  $\frac{1}{4}$  Sec. 7, T. 56, R. 32, thus containing 80 acres of land, and adjoining the Kearsarge on the south. The length of the lode on the property is about 1,600 feet, and crosses the south line at about 850 east from the southwest corner, and bears north about 40° east, dipping northwesterly about 40°.

The work, thus far, has not determined the width of the lode; the shafts being sunk along the foot wall, and no drifting done to the hanging. The chief mineral associated with the copper is epidote, the lode somewhat resembling the Isle Royal and Huron, of which lode it may be found to be the northerly prolongation. The mine is a short distance east from the highway leading from the Allouez to the Centennial, and about midway between those mines. The company has been organized (February, 1882) with a capital stock of \$1,000,000, divided into 40,000 shares, 5,000 of which shares were sold for \$5 per share, to create a working capital.

The officers are: T. W. Edwards, President, Houghton, Mich.; Edward Penberthy, Secretary and Treasurer, Houghton, Mich.; Richard Uren, Agent, Houghton, Mich.

The discovery of the lode is due to Capt. Johnson Vivian, Agent of the Pewabic, Franklin, and Huron Mines, who some years ago when Agent of the Schoolcraft explored this tract, and himself, with Mr. S. L. Smith of Lansing, purchased it from the State. The title was subsequently contested by parties in Houghton, who claimed that it belonged to Houghton county. The State relinquished its claim, cancelling the purchase by Messrs. Smith and Vivian, and the county came into possession of the land, when it was sold to Messrs. T. W. Edwards and Richard Uren, by whom the work now in progress was begun, and who have organized the present company. Some dwellings are being built and preparations are making to build a stamp mill, the water to be supplied by a small stream that courses across the property. A small hoisting engine is at work to raise and lower the buckets, and a small Burleigh compressor is now on the ground ready to be put into operation.

#### THE ALLOUEZ MINE.

It will be remembered that the Allouez Mine had, for several years prior to September, 1880, been worked on a lease, and thus, naturally on the resumption of work on company account, very much had, necessarily, to be done in the way of repairs, and still more, the company has been hampered by being obliged to employ its underground mining force in making new openings. Previous to the expiration of the lease a contract was made with the lessees to open some new ground, and under this arrangement No. 2 shaft was sunk one lift, to the 12th level, and this level was also further connected with the 11th by two winzes. In the lower level 200 feet of drifting was done—100 feet each way—from the foot of the shaft.

The suspension of the company in 1877 was due to financial embarrassment. The indebtedness amounted to \$160,710.38, 111,634.35 of which sum, besides interest to the amount of \$16,390.98, was paid from the proceeds of the lease, the company receiving one-eighth of the copper obtained from the mine by the tributers, thus leaving a balance of \$49,076.03 of the indebtedness still unpaid.

The capital stock was, in April, 1880, by action of the stockholders, increased to the sum of \$2,000,000, divided into 80,000 shares, at which figures it still remains.

The company resumed possession of the property on November 10th, 1880, and immediately made an assessment upon the stock of \$1 per share (\$80,000) to provide funds for the resumption of work.

As previously remarked, it has been necessary to push the openings, and still they are far from being sufficient to meet the requirements of such a mine as the Allouez. No. 2 shaft, the only one which has lately been operated, is now down to the 13th level, having been sunk one lift within the past year, and No. 3 shaft is sinking to the 6th level, and will be continued to the 7th, when it will be connected with No. 2, and will also be used as a hoisting shaft.

No. 2, the deepest shaft, is down 1,150 feet, and the extreme distance from the north end to the south end of the mine is about 1,800 feet. Still further to the north the same lode has an extent on the company's property of 1,116 feet, and south of the mine, the unexplored portion of the lode, on the property, is 784 feet.

The center of the main "shoot" of copper crosses No. 2 shaft at about the 8th level, and makes with the vertical an angle of  $30^{\circ}$ , opening upward to the south. The ground actually worked out in the mine is represented by a block of ground 750 feet to 900 feet wide, and 1,100 feet deep, having the thickness of the lode. The mine is on the south fractional half of Sec. 31, T. 57, R. 32.

A remarkable "slide" extends down through the mine from the surface 200 feet south of No. 1 shaft, and pitching to the north at an angle of  $60^{\circ}$ , crossing No. 2 at the 13th level. This slide is soft clay loam, crossing the formation. The 10th level is extending south to intercept a good shoot of copper that has been found to follow the slide. During the past year the 8th, 9th, and 10th levels have been driven north to nearly No. 3 shaft, and the main copper shoot of the mine is found to continue in these levels. When No. 3 is fitted up into a working shaft, this new ground will be stoped away and hoisted from it. No. 1, the south shaft, is used for the pumping shaft.

The lode bears N.  $39^{\circ}$  E., and dips  $38^{\circ}$  northwesterly; it is a very wide, coarse, conglomerate belt, corresponding with that which further north immediately underlies the greenstone. It is the same belt which is now being opened at the Delaware—Conglomerate Mining Company—though, at the latter mine it is claimed that the belt is richer in copper than it is at the Allouez. They find richer specimens at the Conglomerate than are found to occur at the Allouez, and likewise limited portions of the lode that carry more copper, but to what extent this will affect the average yield to the advantage of the former company remains to be seen. Here, as at the Conglomerate, the belt is very wide—twenty to thirty feet in width—much too wide to work to advantage.

The drifts are carried along the foot wall, and 4 feet or 5 feet of the conglomerate are left next to the hanging to help support it. The hanging wall is exceedingly poor, and requires frequent pillars to be left, together with considerable thickness to the bottoms of the drifts and a portion of the lode in contact with the wall, to support it.

The lode is not uniform in richness. The copper appears to be in seams, where it occurs, alternating, in streaks. It is exceedingly lean in copper, but requires to be all taken down and subsequently sorted, and even then very much of it is stamped that is really worthless. Heretofore the sorting has been done on the floor of the shaft, but a change in the railroad track is being made so that hereafter the skips from up out of the shafts will dump into a chute that will discharge directly into the car standing on the track that

runs to the rock-house, and the sorting, etc., will be done on the rock-house floor. The run is about 300 feet. The rock-house has been enlarged during the year past, and a heavy hammer added to break up the larger pieces; heretofore this labor had to be done by hand. *i. e.* with sledges and drills. The hammer weighs about 3,600, and is like those at other mines, works in a frame like a pile driver, and is raised by machinery to any height necessary to give the requisite fall to break into pieces the rock that is placed under it. The rock-house is now well supplied with every necessary requirement, and is conveniently arranged for economical working.

The machinery has been otherwise improved by the addition of new hoisting gear made at the Portage Lake foundry. Two winding drums, each 12 feet diameter and 8 feet face, and engine 24-inch cylinder, 6 feet stroke, and a new boiler.

The stamp mill is on the west fractional half, S. W.  $\frac{1}{4}$  of Secs. 30, T. 57, R. 32—two and a quarter miles from the mine, with which it is connected by a 3-foot gauge railroad, operated with a locomotive engine.

The improvements at the mill consist of the addition of two Ball stamps in place of those formerly used, and in replacing the boilers with new ones; also a new boiler house has been built.

They have stamped during the year 74,538 tons of rock, which yielded 969 tons 860 pounds of mineral, which, smelted, gave 710 tons 1,403 pounds ingot copper. No. of tons rejected was 12,837, 1-7 of whole number of tons hoisted.

No. of pounds of copper obtained per ton of rock, 19; the average number of miners employed was 94; the average total force employed was 299; the total construction cost was \$63,366.71.

No. of feet of sinking of shafts, 100 $\frac{1}{2}$ ; average cost per foot, \$35.

No. of feet sinking winzes, 57; average cost per foot, \$15.

No. of feet drifting, 1,337 5-12; average cost per foot, \$13.20.

No. of cubic fathoms stoping, 5,943 3-10; average cost per fathom, \$10.22.

Whole number of cubic fathoms broken, 6,592.

The sinking of shafts was all hand work, and the drifting was partly hand, and partly power drill.

The location is very favorable for procuring wood cheaply, as there is no competition for a considerable distance. The wood has cost, this winter, only 2.10 to \$2.75 per cord, and one cord of wood suffices to stamp 13 tons of rock. The shoes on the Ball stamp have to be renewed every five days.

The wood is obtained so cheaply by reason of the fact that the company purchased standing timber of the Canal Company for \$10 to \$12 per acre, and then hired it cut and drawn. The company owns 500 acres of land, having made some recent purchases, including 80 acres of Mr. J. N. Edwards, near the stamp mill; land that was being flowed and covered by the waste sand from the mill, and regarding which overflow an unsuccessful application had been made to the Court for an injunction. The contest was terminated through the purchase of the property by the company.

The other lodes which cross the company's property, have never been explored. The Calumet and Hecla conglomerate should lie to the east of the mine about 2,000 feet, and the Kearsarge conglomerate 1,550 feet further to the east; the Kearsarge amygdaloid 1,150 feet still beyond that to the east. All these lodes are, however, deeply covered by the drift.

The total receipts for the year ending December 31st, 1881, were:



For sale of copper, 1,204,224 pounds, at an average price of 18 8-10 cents.	\$226,488 53
For interest.....	1,473 15
	<hr/> \$227,961 68

The working expenses were.....	\$197,735 18
Lands addition.....	34,945 97
	<hr/> \$232,681 15
Total.....	63,366 71
Construction account—expenses.....	
	<hr/> \$296,047 86
Total expenditures.....	227,961 68

Expenses in excess of receipts.....	\$68,086 18
Receipts from assessments.....	
	<hr/> \$155,206 92
	68,086 18

Surplus on hand.....	\$87,120 74
Inventory of buildings.....	102,600 00
Valuation of machinery.....	185,364 45
Valuations of dams.....	7,500 00

Total valuation of machinery and buildings.....	<hr/> \$295,464 45
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The officers are: Wm. C. Stuart, President. Wm. C. Stuart, John Banta, Edmund Ketchum, E. K. Goodnow, John Stanton, E. Coleman, C. H. Coffin, J. M. Stuart, William Walls, Directors. John Stanton, Secretary and Treasurer, 76 Wall street, New York. Fred. Smith, Agent, Allouez, Mich. James W. Raymond, Clerk, Allouez, Mich.

Since writing the foregoing the following printed report of the company's affairs has been received, and is herewith included.

#### REPORT OF THE ALLOUEZ MINING COMPANY FOR 1881.

At the last annual meeting the company's accounts brought up to the end of February, 1881, were laid before the stockholders, and the directors now present a statement of the operations for the remainder of the year ending December 31, 1881.

The product of the mine during that period (10 months) was 1,645,175 pounds of mineral, yielding 73 2-10 per cent., or 1,204,224 pounds of ingot copper, which realized an average price of

About 18 8-10 cents per pound, or.....	\$226,488 53
Add balance of interest account.....	1,473 15
	<hr/> \$227,961 68

The working expenses at mine as per detailed statement appended, were.....	\$197,735 18
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#### ADD.

Freight.....	\$6,533 42
Smelting.....	18,202 76
Commission and brokerage.....	4,787 18
Marine insurance.....	686 71
Expenses.....	4,735 90
	<hr/> \$34,945 97

Making the total working expense.....	<hr/> \$232,681 15
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And showing a net deficiency of.....	\$4,719 47
There has also been expended in construction of machinery, buildings, etc., as per statement appended.....	63,366 71

Making the total expenditure in excess of production.....	<hr/> \$68,086 18
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The surplus brought forward from last report was.....	\$75,206 92	
Add assessment July 8, 1881.....	80,000 00	
		<u>\$155,206 92</u>

Leaving a net surplus Dec. 31, 1881, as per detailed statement herewith, of. \$87,120 74

The production was considerably diminished by interruptions of work at the stamp mill, caused by breakages of the machinery, and the time occupied in changing the old worn-out stamps, for new stamps of greater power, while the expenses were increased by the large amount of necessary repairs to machinery and fixtures that have been made, and the extra work that has been performed underground in preparing for an increased and regular out-put, the cost of which has been included in the current expenses, the construction account only covering the cost of new machinery, and additions to the equipment.

The mine had for a long time been worked by means of one shaft only, which had reached the twelfth level, and it had become necessary that another shaft should be brought into operation. This has been done as far the 5th level, and substantial hoisting gear placed in position to operate both shafts. A dam across Hill's Creek has also been constructed, and a large reserve of water thereby secured, which, it is believed will be of material assistance in keeping the stamp mill supplied with water in the dry season.

The mine and equipment are now in very much better condition for regular and permanent work than when received back from the lessees in November, 1880, and we anticipate a regular production henceforward, to the extent of the capacity of our stamp mill, now containing two heads of Ball's 15-inch cylinder stamps, and there is reason to believe that before the end of the year another head can be profitably employed.

The details of the expenditures, and of the improvements made will be found in our agent's report, and in the mine accounts herewith submitted.

By order of the directors.

WM. C. STUART, *President.*

NEW YORK, March 14, 1882.

ASSETS AND LIABILITIES, ALLOUEZ MINING COMPANY, DECEMBER 31, 1881.

ASSETS.

Cash.....	\$4,157 37
Loans.....	45,000 00
Accounts receivable.....	2,304 42
Copper on hand, 211,595 pounds, sold for.....	42,209 58
	<u>\$93,671 37</u>

*At Mine:*

Cash.....	\$64 52
Supplies.....	41,561 97
	<u>\$41,626 49</u>

Total assets..... \$135,297 86

LIABILITIES.

Agent's drafts.....	\$21,417 07
Indebtedness at mine.....	21,766 98
Accounts payable.....	4,993 07
	<u>\$48,177 12</u>

Balance of assets..... 87,120 74

STATEMENT OF WORKING EXPENSES AT THE ALLOUEZ MINE FOR TEN MONTHS  
ENDING DECEMBER 31, 1891.

## UNDERGROUND EXPENSES.

Sinking shaft 42 6-10 feet, averaging \$35.....	\$1,491 00	
Sinking winzes 39 feet, averaging \$15.....	585 00	
Drifting 1,041 8-10 feet, averaging \$13.20.....	13,749 80	
Drifting for pillars 84 5-10 feet, averaging \$13.80.....	1,166 15	
Stoping 5,029 2-10 fathoms, averaging \$10.22.....	51,400 30	
Sundry contracts.....	284 00	
Mining captains, timbermen, trammers, and other labor supplies used on company account.....	11,139 45	
	<hr/>	
	\$111,003 74	
Less profit on supplies sold contractors.....	5,844 50	
	<hr/>	\$105,159 24

## HOISTING EXPENSES.

Engineers, firemen, etc.....	\$4,714 15
Fuel.....	6,898 50
Wire rope and other supplies.....	1,493 43
	<hr/>
Cost of hoisting 74,499 tons of rock.....	\$13,106 08

## SELECTING AND BREAKING ROCK.

Mechanics and laborers.....	\$13,118 64
Fuel.....	3,213 70
Castings and supplies.....	2,671 78
Sundry teaming.....	53 50
	<hr/>
	\$19,052 62

## SURFACE EXPENSES.

Superintendence and wages of mechanics and laborers.....	\$7,883 65
Supplies used.....	1,273 97
Telephone line cost.....	193 44
Taxes.....	2,094 07
Insurance on buildings and machinery.....	1,717 39
Teaming.....	314 74
Sundry expenses.....	252 63
	<hr/>
	\$13,729 89
Less commissions on collections, and other credit items.....	2,394 58
	<hr/>
	11,335 31

## RAILROAD EXPENSES.

Engineers, mechanics, and laborers.....	\$3,549 82
Fuel.....	1,686 13
Rails, ties, supplies, and repairs.....	2,209 84
	<hr/>
Cost of transporting 63,362 tons rock.....	7,442 79

## STAMP MILL EXPENSES.

Labor and superintendence.....	\$15,898 90
Fuel (7,205 cords wood).....	19,874 80
Supplies.....	2,467 87
Foundry bills.....	2,920 77
	<hr/>
	41,102 34

Rock stamped, 63,362 tons. Rock stamped, per cord of wood used, 8 79-100 tons. Cost of stamping and washing, 65 cents a ton. Yield of ingot per ton of rock, 19 pounds.

MINERAL EXPENSES.

Transportation to smelting works.....	\$2,752 93	
Mineral barrels and cooperage.....	527 50	
Assay expenses.....	260 00	
		\$3,540 43
		\$200,738 81
Less rents received.....		3,003 03
Net working expenses, March 1 to December 31, 1881.....		\$197,735 18

CONSTRUCTION ACCOUNT.

<i>At No. 1 Engine House:</i>		
Boiler bought of Tribute Company.....	\$1,050 50	
Blake steam pump.....	375 00	
<i>At No. 2 Engine House:</i>		
Addition to building 26x12 feet, new stone cistern, and pulley stands to Nos. 2 and 3 shaft-houses.....	\$2,568 14	
Double friction hoisting gear with foundation, new piston, steam chest and governor, and galvanized heating pipe, etc.....	13,397 82	
<i>At Rock House:</i>		
Addition to building 39x17 feet with new rock chutes.....	\$2,600 00	
Drop hammer with gearing and belting.....	2,596 05	
<i>At Machine Shop:</i>		
New lathe and gearing.....	\$1,504 68	
<i>Underground:</i>		
Three No. 3 Rand drills.....	\$1,817 00	
Seven hundred and sixty-six feet 6-inch air pipe.....	957 50	
One thousand and five feet 6-inch air pipe (lap welded).....	1,175 00	
<i>At Stamp Mill:</i>		
New boiler house, 52x42.....	2,175 00	
Two rotary pumps.....	234 00	
Two new mortars, 8-inch shafts and girts, three 15-inch cylinders, two sills, eight braces, galvanized heating pipe, injector condenser, and three new boilers.....	25,327 84	
Hill's Creek dam.....	7,049 51	
Railroad Creek dam.....	539 17	
		\$63,366 71
Total expenditure.....		\$261,101 89
Estimated value of buildings, machinery, etc., \$102,600.		

MACHINERY.

Hoisting engine and two boilers at No. 1 shaft, with winding gear and feed pump.

Pumping engine and boiler.

Hoisting engine (24x72), and 3 boilers with double friction gear to hoist from Nos. 2 and 3 shafts, heater feed pumps, etc.

Two Burleigh air compressors, pump, 5 Burleigh drills, and 4 carriages, 4 Rand drills, 1,781 feet of 6-inch air pipe.

Upright engine, 6 rock breakers, drop hammer, pulleys, shafting and belting at rock house.

*At Machine Shop*—Two large lathes, 1 drill press, 1 planer, 1 bolt cutter, 1 small engine and driving fan.

One locomotive, 1 large rock car, 9 small rock cars, 2 flat cars, 1 Worthington pump, No. 2; pump in No. 1 shaft to 8th level, pump in No. 3 shaft to 5th level.

*At Stamp Mill*—Two heads Ball's stamps, 2 engines, 3 new boilers and smokestack, 4 old boilers, heater and feed pumps, washing machines, 1 lathe, 1 grate punch, 2 rotary pumps.

Saw mill engine, saws and fixtures.

Total valuation of machinery.....	\$185,364 45
Hill's Creek dam.....	7,000 00
Railroad dam.....	500 00
Valuation of machinery, buildings, etc.....	\$295,464 45

#### AGENT'S REPORT.

ALLOUEZ MINE, MICH., *February 12, 1882.*

JOHN STANTON, Esq., *Treasurer, New York:*

DEAR SIR—I herewith submit my report of operations at this mine, for the period commencing November 10, 1880, and closing December 31, 1881.

On the expiration of the three years' lease of your mine to the "Allouez Tribute Company," the machinery and general mine plant needed considerable repairs. All the remainder of November and the larger portion of December was consumed in making the most necessary repairs; the stamp mill running only part of December, producing 33 765-2000 tons mineral. A force of miners was set to work at once to extend some of the drifts, and engage in other underground work necessary for an active campaign.

No. 2 shaft has been sunk 100 6-10 feet, from the 12th to the 13th level, and passed through a promising lode the entire distance. The drifts from the bottom of the shaft, north and south, advanced 73 and 78 feet respectively, have shown good copper ground. A stope just north of the shaft has furnished very nice stamp rock, and this block of ground promises well for future stoping.

Twelfth level north of No. 2 shaft has been advanced 269 1-10 feet, making the entire distance from the shaft of 325 1-10 feet. For the first 50 feet the stopes yielded very well, but from that point the rock contained a less per cent. of copper. From the present appearance of the ground I look for a change for the better. The 12th level south of No. 2 shaft has been advanced 102 5-100 feet. Total distance from shaft 458 5-10 feet. The drift has been carried 24 feet south of the crossing, and has shown very good copper ground as far as the crossing. The entire block of ground opened by the drift has been stoped down, with good results. This crossing, composed of a large clay seam, with several feet of soft broken rock on either side, is a characteristic feature of this part of the mine. Passing through No. 1 shaft (distant from No. 2 shaft 600 feet) between the 2d and 3d level it has, in its northerly dip reached to within 144 5-10 feet of No. 2 shaft at the 12th level, and heretofore uniformly constituted the southern terminus of the present worked chute of copper ground. On the other hand the productive ground has attained in length to the north of No. 2 shaft more than proportionate to the loss south of the shaft.

The 11th level north of No. 2 shaft has been advanced 226 9-10 feet. Total distance from shaft, 437 feet. The present head of the drift is in fair copper ground, and the stopes have yielded an average quality of rock. The distance to the level above (10th) being 75 feet, the extension of this drift has been discontinued, with the view of stoping the entire block of ground from the 12th to the sole of the 10th level, without any further intermediate



drifting; 320 feet north from No. 2 shaft a winze has been sunk 39 feet, and holed to a rising stope from the level below. This winze was sunk for the purpose of avoiding a large block of unprofitable ground.

The 10th level north of No. 2 shaft has been advanced 180 6-10 feet. Total distance from shaft 596 9-10 feet, and nearly under the line of No. 3 shaft. The stopes worked in this back, although poor at times have on the average produced moderately in mineral. The 10th level south of No. 2 shaft has been advanced 182 2-10 feet south of the crossing. Total distance from shaft 442 2-10 feet. The object of extending this drift was to prove the value of the block of ground entering from the crossing to No. 1 shaft a distance of 340 feet. A trial stope carried up in the back about 20 feet, has produced some copper rock, not sufficient, however, as yet, to prove it to be workable ground.

The 9th level north of No. 2 shaft has been advanced 91 9-10 feet. Total distance from shaft, 525 feet. For the last 60 feet of driving the drift has shown very well. A stope carried up in the back has furnished nice stamp rock. This development is in entirely new ground, none of the upper levels having been opened as far north of the shaft as this point. At the 8th level, 120 feet south of No. 2 shaft, a winze, which had been sunk by the "Tribute Company," for some distance, has been sunk 18 feet further and holed to the stope below. The winze penetrated a block of unproductive ground. Indications, however, in the bottom of the 8th level, and a short distance south of the winze were of such a promising nature that it was considered best to make connection. Although a stope worked near the winze has so far not yielded an average mill rock, still I am confident that this block of ground up to the crossing will amply pay us to stope away.

The 7th level north of No. 2 shaft has been advanced 55 5-10 feet. Total distance from shaft, 250 5-10 feet. The further extension of this level has been resumed with the view of carrying it under the line of No. 3 shaft; it can be run through this level to No. 1 (pump) shaft, and the operating of a second pumping outfit at No. 3 shaft dispensed with. At the same time the drift towards No. 3 shaft will pass through a large extent of virtually unexplored ground, extending from the surface to this depth, and it is more than probable, judging from the appearance of lower levels advanced further north, that we may meet with some paying ground.

The 4th level north of No. 2 shaft has been advanced 35 feet. Total distance from shaft, 125 feet. At times it has carried some copper, not enough, however, as yet, to prove it to be paying ground. It is my intention to drive this level further north, in order to test this long run of new ground.

The 5th level north of No. 3 shaft has been advanced 22 8-10 feet, and has been poor so far, and further driving has been discontinued for the present. Some stoping has been done the past year above the 3d and 4th levels north and south of the shaft, in ground formerly opened. At times considerable copper was met with, but on the whole the rock obtained was below a fair average.

*Total Underground Work:*

Sinking shaft.....	100.6 feet.
Sinking winzes.....	57. "
Driving levels.....	1,337. "
Driving for pillars.....	104. "
Stoping.....	5,943.3 cubic fathoms.
Ground broken in openings.....	549. " "

The copper-bearing portion of our lode occurs mainly in several seams distributed through the lode, with seams or bars of poor ground intervening. The stopes are usually carried to a width of from 14 to 22 feet from the foot towards the hanging wall. Near the foot wall the lode is generally poor for a distance out of from 2 to 5 feet. Although the seams of copper ground contain a fair per cent of mineral, yet taking them in connection with the bars of poor ground, and making such selection of rock when broken and hoisted as is deemed prudent, the average mill rock is still of low percentage.

It will be our aim to sink No. 3 shaft below the 5th level (its present depth) as rapidly as circumstances will allow and connect it with lower levels going north from No. 2 shaft. Part of the shaft (from 9th to 10th level) can be made by stoping. Until we are enabled to draw more mill rock from No. 3 shaft, almost the entire supply has to be hoisted through No. 2 shaft, which, with all possible care and attention, is attended with some drawbacks and risks.

Our construction account for the past year has been of considerable magnitude, and as it entered into all our principal working departments, has, consequently, caused some shortage in production, and an increased cost of such production.

Construction consisted of:

*At the Stamp Mill.*—Two mortars and 8-inch shafts and girts; 3 15-inch cylinders, sills and braces; heating pipes, rotary pumps, and injecture condenser; 3 large flue boilers, and boiler house 52x42 feet; the boilers have ample capacity and furnish the required steam power with ease; the stamping machinery is doing good duty.

*At the Rock House.*—Addition to building 39x17 feet, and large drop hammer with gearing and belting, also new rock chutes. The drop-hammer constitutes a valuable addition to the outfit of this part of the plant.

*At No. 2 Hoisting Works.*—Stone foundation for gearing; friction hoisting gear for two shafts; cap stone for engine bed; piston steam chest and governor for hoisting engine; Worthington pump and galvanized heating pipe; large stone cistern; addition to building 26x12 feet, and pulley stands to No. 2 and 3 shafts. The hoisting gear is a substantial piece of work; it gives perfect satisfaction, and will be of sufficient power to hoist our rock for a considerable depth.

*At No. 2 Hoisting Works and Compressor House.*—A nearly new locomotive boiler put in by the "Tribute Company," and bought of them; one No. 6 Blake steam pump.

*At Machine Shop.*—We added to the former outfit a large new lathe with gearing, which will enable us to do a line of work that formerly we had to have done by outside parties.

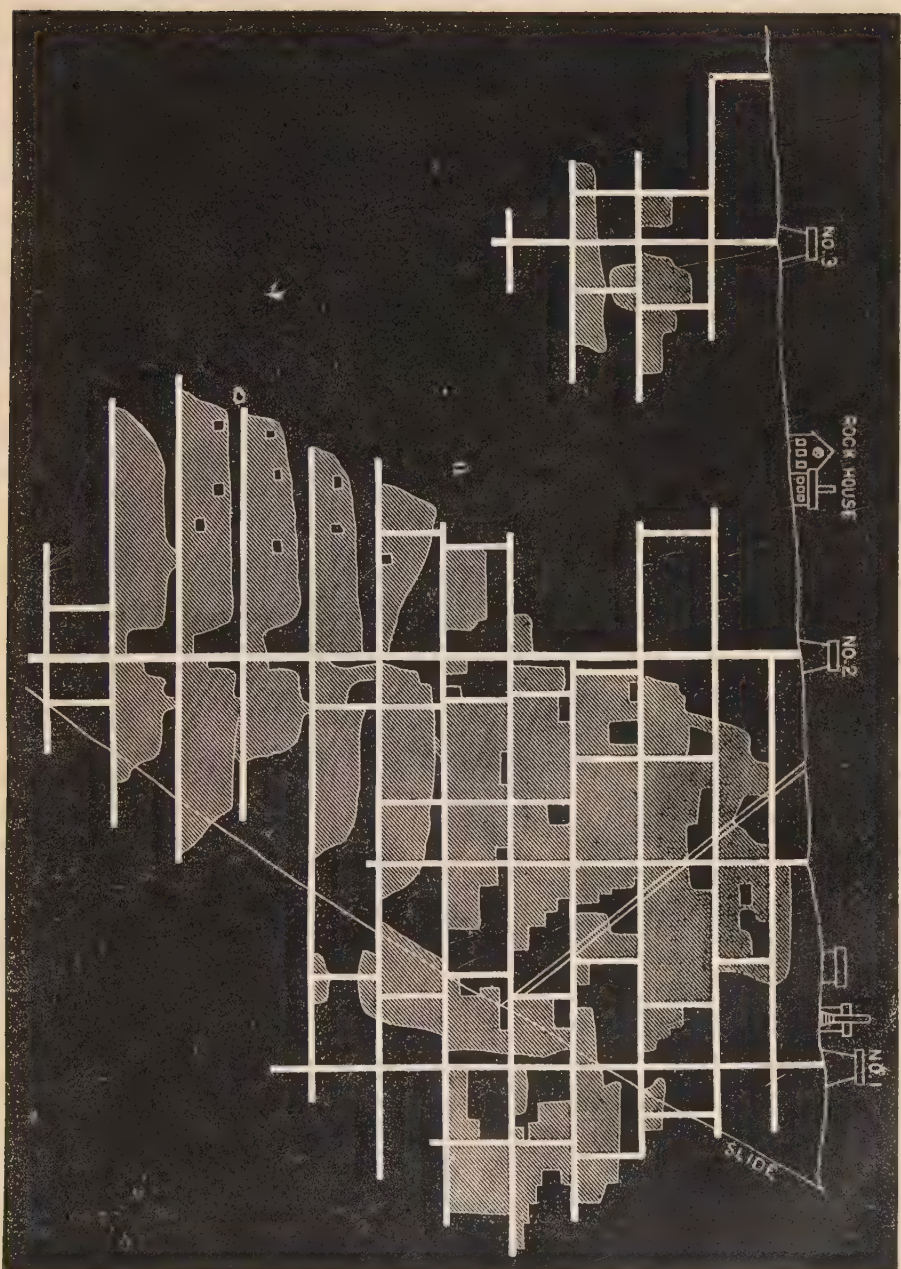
*Underground.*—We added 4 No. 3 Rand power drills, together with 1,005 feet 6-inch air pipe.

*On Hill's Creek,* the stream furnishing the main supply of water for our mill, we have built a large and substantial dam, which, when filled, will hold a body of water, that with the inflowing stream and a portion drawn from the well outside the mill, will furnish enough to run two heads of stamps throughout the year. We have not drawn any water from the Gratiot River since the setting in of winter, and do not now anticipate any shortage during the winter, from our present source of supply.

The tables of cost prepared by Mr. Raymond, our clerk, show in detail

LONGITUDINAL SECTION OF THE ALLOUEZ MINE.

Scale, 300 ft. to one inch.









the work performed in the several departments, and its relative cost, also the cost of construction.

In conclusion it gives me pleasure to state that my associate officers have been untiring and faithful in the performance of their share of the past year's work. Yours very respectfully,

FRED. SMITH, *Agent*.

#### THE PORTAGE LAKE MINES.

The Portage Lake mines are embraced in the territory extending from the village of Red Jacket south-westerly along the range to the Atlantic, an area that has no equal in the history of copper mining anywhere in the world; and as to that matter few mining regions, of whatever kind, can be compared with it on a basis of equality, either in the richness of the lodes or in economy of working. It may be safely asserted that no mineral deposit ever discovered has possessed the extent of uniform metallic richness of the Calumet and Hecla Conglomerate. With all the enormous expenditure of the company, the mine has probably returned more money to the stockholders, in proportion to the amount invested, than any other mine has ever done; and its future, for many years to come, is nearly certain to be equally prosperous, so far as the yield of the mine is concerned.

The other leading mines of this district, as the Osceola, Atlantic, Quincy, etc., while mining in leaner deposits, have made a record for economy of working that is unparalleled. For percentage of cost at which the metal is produced, these mines may challenge comparison with any in the world.

The copper district has extraordinary resources as a mining region, that, aside from the phenomenal purity of the metal and the richness of the lodes in which it occurs, gives it great advantages over any other copper district in America. The whole range is within a short distance of Lake Superior, thus affording to the mines water communication with the whole world; it has an abundance of timber; it is an elevated and remarkably healthy region, having pure air and plenty of pure water; and not least among its important advantages is the fact that it has a cold climate. There is no trouble nor will there be, in the deep mines on Lake Superior regarding an excess of heat and want of ventilation. With a proper arrangement of the shafts, "pipes," or "chimneys," etc., the cool, pure air of the country will penetrate to the bottoms of the deepest mines, and the smoke and vitiated atmosphere will as readily circulate to the surface.

The eruptive forces, whose agencies can be traced in the original formation of this wonderful region, have long ago subsided; no uneasy, imprisoned volcanic spirit disturbs the quiet, settled earth; no subterranean hades emits its noxious vapors to render poisonous the health-giving air. For unnumbered ages this limited but ever ancient portion of mother earth has remained undisturbed, save only by the slowly disintegrating, meteorological forces of nature. The mountains which once reared their heads along this range, have been abraded to mere hillocks by the irresistible grinding of ancient glaciers; and the debris, borne along on these rivers of ice, lie scattered over the country far to the south, to the Mississippi.

This peninsula of Northern Michigan, from its great extent of navigable coast line, from its accessibility, and the ease with which it may be traversed, from the plentifulness and purity of its waters, from the coolness and salu-

brity of its climate, from the extraordinary richness, extent, and variety of its mineral deposits, stands pre-eminent among the mining regions of the earth. Its deposits of copper and iron are nowhere surpassed,—nowhere equaled, and from no other region can those minerals with less difficulty or greater economy be mined and transported to the markets of the world.

### THE ATLANTIC.

In the copper region the richest deposits, so far as now known, are found in Houghton county, and of the mines which are worked in this district, the most southerly is the Atlantic; noted, not for the richness of the lode which is mined, but for the excessive leanness of the deposit, and the remarkable fact that from this comparatively barren belt—yielding only fourteen and a third pounds of copper to the ton of rock—a profit can be secured; that all the expenses pertaining to the equipping and operating of a first-class copper mine can be fully met, and annually—year after year—a dividend be paid to the stockholders! That such a result can be achieved illustrates the great advancement of mining work on Lake Superior. The problem has been thoroughly worked out, the cost in every department of the mining work carefully itemized, and the whole so conditioned, that the entire expenditure is brought within the conditions that secures a surplus. A few years ago it would not have been possible to accomplish the results now achieved at the Atlantic. Air compressors, power drills, high explosives, a more thorough knowledge of mining work,—the conditions to be met and difficulties to be overcome—a more careful attention to details have led to this remarkable success.

It will be remembered that the predecessor of the Atlantic, the South Pewabic, operating the same mine, was entirely ruined in the enterprise. After exhausting its capital stock and expending upwards of half a million of dollars besides, and, in addition, having an unpaid indebtedness, the company went into bankruptcy, and a new organization—the Atlantic—operating the same property, began its existence in 1872. But the old company, while shipwrecked itself, accomplished very much that made possible the success of the new. It had opened the mine and demonstrated the uniformity and yield of the lode; it had built the great stamp mill at the lake, and substituted for the costly pumps originally used the more simple and effective launder that supplies it with water. It had located and constructed the railroad to the lake. It had introduced the elevated automatic railway, now an indispensable adjunct at all the important mines. Thus the old company had paved the way—with gold it may be—had done a great proportion of the essential, preliminary work for the new. And the new company with a clean sheet, a tolerably well-equipped mine, a pretty thorough knowledge of the situation, derived from the experience of its predecessor, began a career which under the excellent management that has characterized the history of its affairs, has been, when we remember the poverty of the lode, in a remarkable degree successful.

The Atlantic lode is a very wide amygdaloid belt, running and dipping with much regularity. It is said to be uniform; by which it is meant that it is everywhere equally productive, and this is measurably true. When compared to many other amygdaloid deposits, it is certainly uniform; but in reality a great deal of the vein is practically barren, the copper occurs in small bunches—pockets—particles of copper occurring here and there, so that it is not easy to tell where it is and where it is not. Careful searching may fail to disclose

any copper in the surface of a rock, yet in the interior it may be found. Some portions of the lode are richer than others, yet in nearly all of it a little copper may be found; but everywhere the percentage is so small that it don't pay to select it, to attempt to sort out the worthless rock; the only way is to mill it all, the comparatively good and the poor, and get the average result. So that with the exception of the pillars that are left to support the hanging wall, the lode is all taken down; the mine is like an underground quarry; the problem is how the most economically and safely to remove the deposit and to support the insecure hanging wall. There is no dead work in sinking and drifting in search of ground that will pay to stope; they push right along and it all goes to the stamps.

The inclination of the lode is  $45^{\circ}$ , northwesterly, so that the lode, in dip, in width, and in uniformity of composition, is favorable for economical working. The only serious drawback is the unstable character of much of the hanging wall. A great deal of timbering is required to sustain it, and even then very much of it falls, sometimes in great bodies, crushing the timbers and all beneath it. One wonders that the workmen do not get killed working beneath these ponderous rocks that seem liable to fall at any moment, but they do not. Capt. Tonkin states that no person has ever been killed, in this manner, in the mine. When working beneath a roof that gives indications of falling it is carefully watched. The men insert wedges in the seams or cracks, and observe the progress of loosening which takes place. Besides, when about to fall there is generally a preliminary movement and slight noise, which men working in danger are quick to observe and thus to make their escape. The most lamentable instance of a fall of this kind in any of our copper mines, occurred at the Copper Falls, in 1874, when seven men were crushed beneath an extensive fall of the roof, and before their bodies could be recovered from the ruins they were so badly eaten by the rats as to be almost unrecognizable. Rats infest the copper mines, and they are of great value, acting as scavengers,—removing all the refuse and filth which, otherwise accumulating, would be unendurable.

But to return from this digression. The uniformity of the Atlantic lode, its width and steepness of pitch, as previously stated, favor a modification of mining it, greatly to the company's advantage. No sinking or drifting is done in the sense that is practiced in most other mines. The vein is one great stope, and it is cheaper to pay \$13 to \$14 per fathom for stoping than to pay \$30 or \$35 per foot for sinking. If the vein were less uniform, having stretches of barren ground, etc., it would be necessary to open ahead to extend long exploring drifts, in order to find the good ground and escape the poor.

The mining work is let to parties at different prices. The advancing party takes out the whole width of the vein from foot to hanging, and a track is laid along the hanging, and stulls and lagging are placed in along on the opposite side, far enough removed to give space for a platform between the line of stulls and the track for a platform sufficiently elevated to bring it at the same height of the top of the cars. A second party, working one or two drills, follows, taking out as before the entire width to a height of twenty feet, then a third, and so on, the "dirt" or loose rock being allowed to roll down against the lagging, whence it is drawn out on to the platform and shoveled into the cars, and trammed to the shafts. About eight feet of ground is left in the bottom of the drifts, and pillars are left upon either side of the shafts and elsewhere, also, as deemed necessary. To secure the ventilation, etc., instead of lowering a winze, it is simply necessary to break a hole through the bottom



of the drift. The shafts in the same manner are stoped out from below, carried up instead of being sunk, as it is cheaper to allow the rock to roll down to the track in the bottom of the drift than to hoist it, as is constantly necessary in sinking. The tracks follow the hanging and have some curvatures, due mainly to the widening and narrowing of the vein.

The men advancing the lower drift, while carrying the whole width of the vein are paid as if it were a drift, i. e., they receive \$10 per foot for drift, 5 ft.x6 ft., and \$12 per fathom for the remainder of the vein, embraced in their contract but carrying both along together. The second party receives \$9 per foot and \$10 per fathom, or the price paid may be \$7 per foot and \$9 per fathom. The price varies somewhat, depending on the width of the lode, character of the roof, etc.,—the wider the vein the cheaper it is stoped.

The contracts are made for three months, and may prove favorable or otherwise to the miners; they take their chances and must abide by the result. But they make wages anyhow, and usually realize about the same result, financially. If their contract proves an easy one they work shorter shifts—eight or nine hours. If it is a hard one they work harder, ten or twelve hour shifts—that is all. Dikes of trap occasionally occur rising up from the foot wall, but they never extend to the hanging,—across the vein.

No. 3 shaft is down to the 12th level, the deepest point in the mine. Here a pocket of unusually rich ground was intercepted, yielding largely in barrel work. Great hopes were entertained that a new era had dawned in the experience of the Atlantic. Greater depth having been reached an increased richness in the lode was found to occur; but these pleasant anticipations were doomed to disappointment, and the necessity still exists of exercising on the part of the company its accustomed economy. As the opening enlarged the vein assumed its normal condition of richness, or rather, leanness. This rich pocket extended about 15 feet to the north of the shaft, and about the same distance to the south.

No. 11 drift is extended south towards No. 4 shaft, or beneath and beyond it, as No. 4 is only to the 9th level, but they will rise up in the shaft. In this drift there are now 5,000 or 6,000 tons of rock lying against the lagging ready to remove. The stulls, lagged up, answer as bins to hold the rock. Holes are cut through the lagging to let it out upon the platform; it is thus very readily and cheaply handled. This drift (No. 11) extends north from No. 3 shaft 400 feet, but is not yet connected with No. 2 shaft.

In the 10th level, north from No. 3, it is opened 700 feet; 100 feet more will connect it with No. 2. The end of this drift is looking extremely well, and yields considerable barrel work in addition to an increased percentage in the yield of the stamp rock. In this drift a large amount of the roof has fallen.

The 4 shafts are connected in the 1st level, and Nos. 4 and 3 shafts are connected in all the levels down to the 10th, and Nos. 2 and 3 in all levels down to the 9th. The 4th, 5th, and 6th levels are extended from No. 4 1,200 feet, and 5th and 6th about 900 feet.

The work in the mine is admirably distributed, avoiding all interference and securing the greatest possible accomplishment. No more than two drills—seldom more than one—are used in a drift, and they are not allowed to be idle; at noontime part of the men, operating the drill, eat at a time; the others keep it at work.

The underground filling and tramming at the Atlantic is done at a lower cost than at any other mine—the average cost per ton being only 17½ cents. The



trammers get \$1.50 per day, and a set works in each drift. Tally is kept in the engine house of the number of skips hoisted for each party, and it is thus known every night how much each has sent up, and so a check is kept on their work; that is, it is known how much the party should do, and if the work does not equal the requirement the men may be called to an account. There are just enough men kept in a place to work to advantage. One car works in a place, that is to tram in the same level in the same direction, to the same shaft. The amount sent up by a party varies with the distance they have to tram. In the 10th level tramping 700 feet from the south end of the drift, a party will send up 18 to 21 skip loads in 10 hours if they take from the drift. If they load from the platform they will send up 21 to 22 skip-loads in 10 hours.

In the 11th level, where the runs are short, they will send up 25 skip-loads in the same time. Two men work each car.

The following results are obtained from tabulating all items of cost and securing the average; treating the rock at the rock house, including expenses of engine and all other expenses:

Cost per ton of rock.....	\$0 11
“ “ “ “ “ for tramping and filling in the mine.....	17½
“ “ “ “ “ for railroad transportation.....	5½
“ “ “ “ “ for stamping, washing, including repairs and new machinery at stamp mill.....	42½
Entire cost per ton of rock, including all expenses of the mine.....	1 75

When we consider that this rock is mined 500 feet to 1,000 feet under ground, is tramped to the shafts and hoisted to the surface, taken to the rock house and passed through the breakers, transported by railroad four miles to the mill, and there stamped and washed, and the whole done at a cost of \$1.75 per ton of rock, that yields only 14½ pounds of copper, it is unnecessary to comment upon the skill and economy of the management. With the copper selling at an average price of but little above 17 cents per pound, and making a net profit for the year of upwards of \$82,000, is a record of which any company might well be proud.

The Atlantic always comes up to its promises; whatever is predicted for the ensuing year is certain to be realized—in striking contrast to the history of some old companies in the earlier days, which in each prospectus promised great things and realized the reverse.

The length of the mine is 3,230 feet. No. 1 shaft is 250 feet down; No. 2, 800 feet; No. 3, 1,100 feet; No. 4, 900 feet.

They are connected on the surface by a straight, elevated, automatic railroad, which extends also to the rock-house, standing in line of the shafts. The car starts from No. 2 with a skip-load, 1½ tons of rock, and runs to No. 3, then stops and takes another skip-load, and runs on to the rock-house.

A new compressor building, pump-house, No. 3 shaft-house, have been constructed within the last year, the old having been destroyed by fire in June last. The new structures are of stone, with slate roofs and substantially built.

The engine and hoisting machinery for No. 3 and No. 4 shafts is placed between the compressor building and the rock-house. No. 2 hoisting machinery is in a separate building, standing north from the shaft. The machinery is first-class. The compressor, a new Rand duplex—is now operating 16 power drills.

The great pumping engine is a magnificent piece of workmanship, 22 feet cylinder, 8 feet stroke; wood is used under the boilers, the stock of which for the coming year is now being drawn and ranked, and costs \$2.80 per cord, first-class hard wood. Capt. Tonkin bought the timber standing, and hires it cut and drawn. The dwellings and other buildings on the location are sufficiently commodious and substantial.

A foreign gentleman, interested in mining, lately visited the Atlantic, went through the mine, the stamp mill, over the railroad, observed the cars whirling along the high trestle to the great rock-house, the comfortable dwellings for the workmen, the costly machinery, etc., and realizing the magnitude of it all, exclaimed: "All this on three-fourths of one per cent?"

The details of the working of the mine and the financial statistics, etc., will be found in the following annual report of the company for the year 1881. I also include an interesting table of statistics of the Atlantic Mine, prepared by E. P. Kibbie, editor of the Northwestern Mining Journal.

#### REPORT OF THE ATLANTIC MINING COMPANY FOR THE YEAR 1881.

The directors present the following statement of operations during the year 1881:

The production of mineral was 3,632,841 lbs., which yielded 69 59-100 per cent., or 2,528,009 pounds of refined copper. The shipments to market during the year amounted to 2,546,344 pounds, which realized an average price of 17 12-100 cents per pound. The following is a summary of the year's business:

#### PRODUCTION.

Copper sold (2,546,344 lbs. at 17 12-100 cents).....	\$435,975 22
Copper at smelting works, Dec. 31, 1880.....	\$53,608 00
Copper at smelting works, Dec. 31, 1881, 291,346 lbs., valued at 16 cents net.....	46,615 36
	<u>6,992 54</u>
Net value of product of 1881.....	\$428,982 59

#### COSTS.

Working expenses at mine, as per clerk's tables.....	\$290,448 82
Smelting, freight, and all other expenses as per balance sheet..	55,581 22
Net operating expenses.....	<u>346,030 04</u>
Showing a net profit in 1881.....	\$82,952 55
The amount expended in completing outfit of power drilling machinery, and charged to construction account was.....	7,372 13
Leaving as net gain in 1881.....	<u>\$75,580 42</u>
The surplus, Dec. 31, 1880, estimated at.....	\$263,320 02
included 738,896 lbs. copper then unsold, valued at 8½c., but which only realized 16 3-100c., a reduction of.....	18,208 80
The actual surplus Dec. 31, 1880, being.....	<u>245,111 22</u>
Making the net surplus, Dec. 31, 1881.....	\$320,691 64

As shown in detail in the annexed statement of assets and liabilities, from which a dividend of \$2 per share (\$80,000) was paid February 1, 1882.

The tables of the amount of work performed in each department, and the cost thereof, together with the detailed description of the mine and of the operations during the year, contained in our agent's report, will, it is believed, furnish all the additional information desired by stockholders.

JOSEPH E. GAY,  
GEO. A. HOYT,  
JOHN R. SUYDAM,  
JOHN J. CRANE,  
JOHN STANTON,

NEW YORK, March 14, 1882.

*Directors.*

BALANCE SHEET, ATLANTIC MINING COMPANY, DECEMBER 31, 1881.

REAL ESTATE.

Mines, railroad, stamp mill, and machinery, as valued at consolidation .....	\$659,642 11	
Woodlands purchased .....	16,664 41	
General expenditure previous to 1881 .....		\$676,306 52
		2,863,582 65

EXPENDITURES IN 1881.

Atlantic mine .....	\$298,452 83	
Freight .....	13,021 02	
Smelting .....	32,210 39	
Insurance .....	1,820 56	
Brokerage .....	2,211 43	
Storage .....	298 30	
Expenses .....	5,641 21	
Interest .....	378 21	
		354,034 05
Dividends .....		60,000 00
Cash .....		74,233 42
Copper bills .....		21,468 61
Copper on hand, (sold, 637,974 lbs.) .....		122,412 14
		\$4,172,087 89
Capital stock as consolidated, (40,000 shares of \$17.50 paid in) .....	\$700,000 00	
Assessment on stock of Adams Mining Company .....	853 15	
Assessments Nos. 1, 2, 3, 4, and 5 .....	280,000 00	

SALES OF COPPER.

Sales previous to 1881 .....	\$2,748,163 21	
Sales in 1881 .....	435,975 23	
		\$3,179,138 44
Accounts payable .....		12,095 80
		\$4,172,087 39

ASSETS AND LIABILITIES, ATLANTIC MINING COMPANY, DECEMBER 31, 1881.

ASSETS.

Cash .....	\$74,283 42
Copper bills .....	21,468 61
Copper on hand, 637,974 lbs., sold for .....	122,412 14
Copper at smelting works, 291,346 lbs., valued at 16 cents net .....	46,615 36
	\$264,779 53

## AT MINE.

Cash.....	\$1,394 02	
Coal.....	12,730 00	
Wood.....	8,626 09	
Supplies.....	26,304 48	
Merchandise, provisions, etc.....	50,825 84	
	<u>          </u>	\$99,880 34

Total assets.....\$364,659 87

## LIABILITIES.

Agents' drafts outstanding.....	\$13,160 25	
Indebtedness at mine.....	18,712 18	
Accounts payable.....	12,095 80	
	<u>          </u>	43,968 23

Balance of assets.....	\$320,691 64	
Mine plant, consisting of engines, stamp mill, implements, etc., as per inventory.....	379,637 08	
Timber lands.....	16,674 41	
	<u>          </u>	\$396,311 49

## STATEMENT OF WORKING EXPENSES AT THE ATLANTIC MINE FOR THE YEAR ENDING DECEMBER 31, 1881.

## UNDERGROUND EXPENSES.

Sinking, 104 8-10, average \$17.51.....	\$1,835 35	
Drifting 1,856 5-10 feet, average \$10.08.....	18,708 30	
Stoping 8,942 139-216 cubic fathoms, average \$11.17.....	99,888 03	
Timbering, tramming, and labor.....	40,440 84	
Powder, candles, fuse, etc., used on company account.....	1,773 10	
	<u>          </u>	\$162,643 62
Less profit on supplies.....	27,293 60	
	<u>          </u>	\$135,350 02

## SURFACE EXPENSES.

Labor, supplies, and materials used, after deducting credit items.....	\$67,925 63	
Feed for teams, shoeing, etc.....	2,154 68	
Fire insurance.....	316 56	
Taxes.....	3,531 51	
	<u>          </u>	\$73,928 38
Less amount received for rents.....	3,750 44	
	<u>          </u>	70,177 94

## RAILROAD EXPENSES.

Labor.....	\$6,526 03	
Fuel.....	3,190 00	
Supplies and materials.....	1,098 77	
	<u>          </u>	\$10,814 80
Less amount charged for hauling freight.....	783 55	
	<u>          </u>	10,031 35

## STAMP MILL EXPENSES.

Labor.....	\$25,461 35	
Fuel.....	35,116 75	
Supplies and materials.....	13,718 23	
Insurance.....	593 28	
	<u>          </u>	

Total cost of stamping and washing 176,055 tons of rock..... 74,889 61

Total running expenses in 1881.....\$290,448 82



CONSTRUCTION ACCOUNT.

Second half of Rand's Duplex Compressor.....	\$3,400 00
Eleven new power drills.....	3,720 00
Materials, etc.....	252 13
	<hr/>
	\$7,372 13
Total expenditures at mine.....	\$297,820 95

AGENT'S REPORT.

ATLANTIC MINE, L. S., MICH., }  
January 1, 1882. }

JOHN STANTON, ESQ., *Treasurer Atlantic Mining Company, New York:*

DEAR SIR—The following is a statement of work done, and the results of the same, for the year ending December 31, 1881.

No. 2 shaft has been extended within a few feet of the 9th level, and is in working order to the 7th level.

The 9th level has been driven 105 feet north to No. 2 shaft, and is close to the transverse vein. There is a quantity of ground to stope in the back between Nos. 2 and 3 shafts, which will be left until No. 2 shaft is in working order to this level.

The 8th level has been drifted 120 feet north of No. 2 shaft, but is still in the strip of barren ground which extends each side of the transverse vein.

The 7th level has been extended 195 feet north of No. 2 shaft, and the show is very good in the present end. Some very good rock has been broken from the back of this level.

The north end of the 5th level is now 420 feet north of No. 2 shaft, and 320 feet south of No. 1 shaft. A large quantity of rock has been taken from this back, but the yield has been hardly up to the average of that taken from the other parts of the mine.

The 3d level now extends 270 feet north of No. 2 shaft, the back producing about the same grade of rock as the 5th level.

No. 3 shaft has been sunk from the 11th to the 12th level, and the drifts at the 12th level have just been started. We have taken from this shaft splendid stamp rock, also a quantity of barrel copper. I think this lift has opened the most coppery ground I have ever seen in the mine.

The 11th level has been extended 300 feet north and 300 feet south of No. 3 shaft with good results. A large quantity of good rock has been taken from the back of this level.

The 10th level north of No. 3 shaft is 510 feet in length. The treacherous nature of the hanging wall necessitated the leaving of a large quantity of good rock standing in the back. I find, as we attain depth, that the hanging wall is getting weaker and requires more pillars, larger arches, and an increased quantity of timber to keep the mine in a safe condition.

No. 4 shaft has been connected with the 10th level. We are driving and stoping in the 10th, 9th, 8th, and 7th levels south of No. 4 shaft with about the same results as in the past.

Number of feet sunk.....	104 8-10
Number of feet drifted.....	1,856 5-10
Number of cubic fathoms stoped in rising stopes.....	1,110 179-216
Number of cubic fathoms stoped in ordinary stopes.....	7,831 176-216
Total amount of cubic fathoms broken in openings and stopes.....	9,240

There has been quite a reduction in the price of breaking ground compared with 1880, caused by working power drills. At the opening of the year we were working five drills, and have since increased the number to 16.

#### STAMP MILL.

The mill has stamped and treated 176,055 tons rock, at a cost of 42 54-100 cents per ton. The yield being 20 63-100 pounds of mineral, or 14 36-100 pounds refined copper for each ton of rock treated.

The machinery is in good condition, and has done the work very satisfactorily.

#### RAILROAD.

The railroad is in good condition. During the year we put in 666 new ties, and have taken a large quantity of dirt from the cuts, to finish filling in the ravine near the mill, which was spanned by a large bridge. The amount of rock transported over the road is 176,055 tons, at a cost of 5 7-10 cents per ton. The freight carried from the dock to the mine is 788 1987-2000 tons, the expense of which is charged to the different accounts. The locomotives and rolling stock are in good repair and running condition, and are able to do the required work of the road for years.

#### MACHINERY.

On the 29th day of June last we had a very severe accident. A fire broke out in the top of No. 3 shaft-house, and a strong wind carried the flames upon the pump, and compressor houses, destroying all the woodwork of the houses and machinery. The pump was started in 3 days, the compressor in 14 days, and hoisting from all the shafts by the 25th of July.

The compressor-house is built of stone, and covered with a slate roof, as also are the pump and boiler-houses. The cost of rebuilding the portions destroyed by the fire is about \$3,500. The rock-breaker engine and machinery, the hoisting machinery, pumping engine and machinery, and compressor machinery are all in good working condition.

#### CONSTRUCTION.

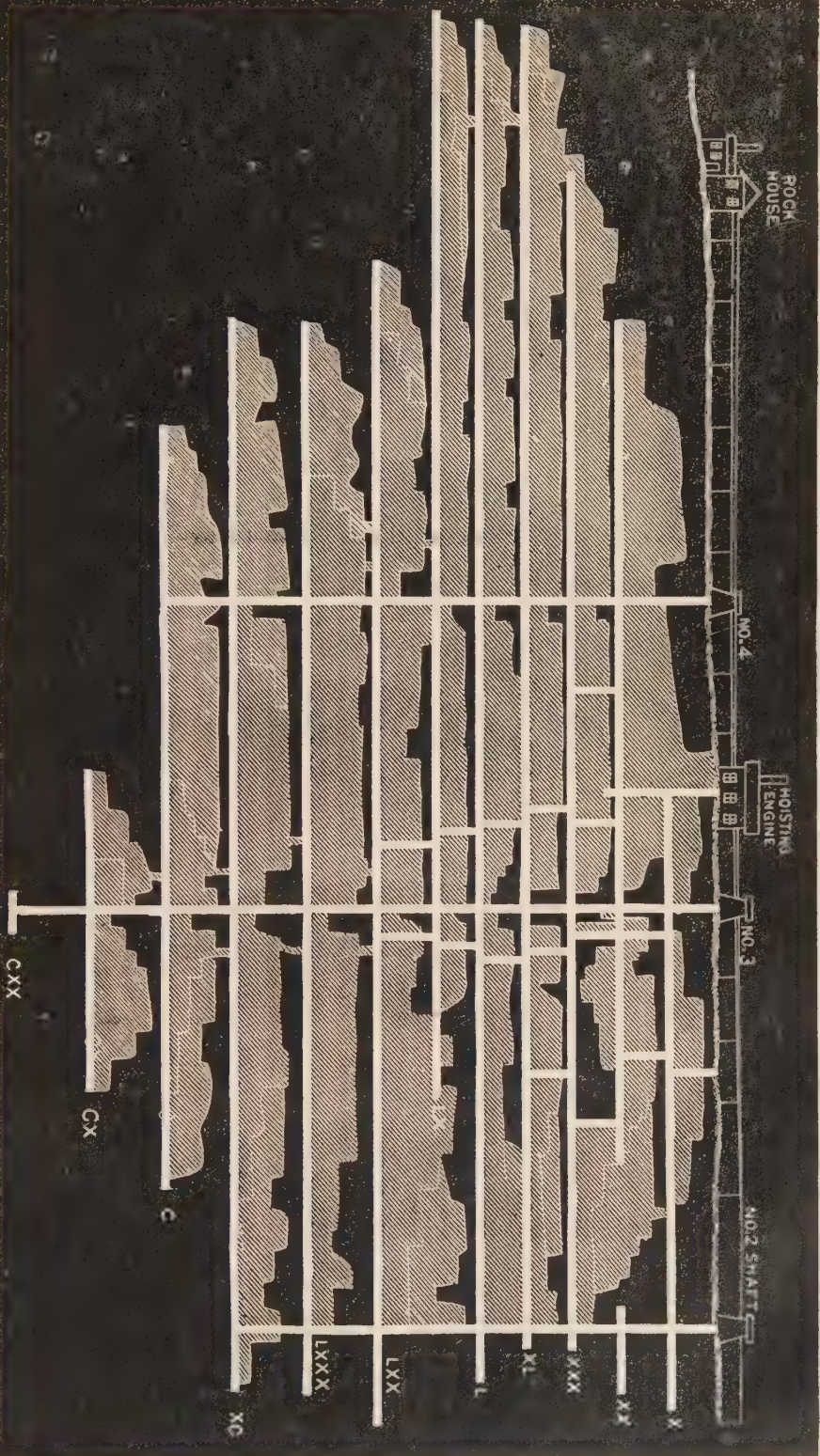
The construction for the year consists of one-half of Rand's Duplex Compressor, 2 Rand drills, and a donkey engine for underground purposes.

In conclusion I would say that with the present appearance of everything connected with the mine, the prospect for 1882 is as good, if not better than that of 1881. Yours very respectfully,

WM. TONKIN, *Agent.*

# LONGITUDINAL SECTION OF THE ATLANTIC MINE, JAN., 1882.

Scale, 300 ft. to one inch.









STATEMENT of Production, Cost, and Results from Atlantic Mine, 1875 to 1881 Inclusive.

ATLANTIC MINE.	1881.	1880.	1879.	1878.	1877.	1876.	1875.
Total product, mineral, pounds.....	3,632,841	3,353,190	3,257,085	2,847,899	2,890,378	2,665,216	2,178,897
Product of ingot copper.....	2,528,009	2,425,225	2,339,073	2,007,075	2,094,304	1,855,041	1,567,036
Percentage of mineral.....	72.28	72.28	71.81	70.44	71.32	68.85	71.92
Gross earnings.....	\$428,982	\$468,474	\$392,592	\$322,593	\$378,141	\$385,292	\$354,759
Net operating expenses.....	346,030	384,083	285,765	311,268	323,572	342,371	312,170
Per cent of expenses to earnings.....	80.66	81.98	72.78	96.83	85.56	88.86	88
Construction expenses.....	\$7,372 13	23,849 66	11,834 42	26,673 50	13,008 74	5,422 68	14,532 41
Profit, including construction account.....	82,952 45	84,391 01	106,827	11,325 06	54,569 86	42,880 55	42,519 67
Dividends paid.....	80,000 00	40,000 00	20,000 00	20,000 00	182,634 00		
Surplus undivided.....	320,631 64	263,320 00	147,286	147,286	13.83	137,043 00	39,555 00
Total mining cost of ingot copper per pound.....	11.43	13.54	10.18	14.41	13.83	15.99	19.26
Smelting, marketing, and other expenses per lb.....	2.20	2.30	2.02	2.42	2.54	2.96	2.86
Average cost per pound, marketed.....	13.68	15.84	12.20	16.83	16.37	18.95	22.12
Average sales of ingot copper per pound.....	17.12	19.97	16.30	16.15	18.54	21.35	22.47
Tons of rock stamped.....	*176,055	*169,825	122,668	111,709	105,780	96,696	80,000
Yield of mineral per ton of rock stamped.....	20.63 lbs.	19.74 lbs.	26.55 lbs.	26.25 lbs.	27.83 lbs.	27.56 lbs.	27.23 lbs.
Yield of ingot per ton of rock stamped.....	14.36 "	14.27 "	19 "	18.50 "	19.42 "	18.99 "	19.58 "
Cost per ton, stamping and washing.....	42.54 cts.	38.13 cts.	42.44 cts.	48.85 cts.	57.79 cts.	67.09 cts.	87.96 cts.
No. fathoms broken in openings and slopes.....	9,240	9,929	8,665	8,299	7,091	6,550	5,628
Yield of mineral, per fathom.....	393 lbs.	337 lbs.	375 lbs.	343 lbs.	406 lbs.	406 lbs.	387 lbs.
Yield of ingot copper per fathom.....	273½	244 "	266 "	243 "	289¾	280¾	278¾
Average force employed.....	322 men.	410 men.	370 men.	363 men.	352 men.	333 men.	316 men.
Fathoms of ground broken for each employee.....	27.83	24.21	23.41	22.55	20.14	19.67	17.80

\* The cars formerly estimated to hold four tons each were found by weight to hold five tons, hence the apparently large increase in the number of tons stamped in 1880 and 1881, as compared with previous years, the decreased yield of mineral and ingot per ton, and the reduced cost of stamping and washing.

The following is a statement of totals and averages, of product, cost, etc., of the Atlantic mine, from 1875 to 1881, both years inclusive:—

Total product mineral, pounds.....	20,819,506
Average product (yearly) of mineral, lbs.....	2,974,215
Average percentage of mineral.....	70.88
Total product of ingot copper, lbs.....	14,752,753
Average product of ingot copper, lbs.....	2,107,536
Average mining cost of ingot copper, per pound.....	14.31 cts.
Average smelting, marketing, and other expense, per pound.....	2.47 cts.
Total cost of ingot per pound, marketed.....	16.78 cts.
Average sales of ingot copper, per pound.....	18.84 cts.
Average profit per pound on ingot, marketed.....	2.06 cts.
Total tons of rock stamped.....	*991,946
Average tons of rock stamped, per year.....	141,706
Average yield of mineral per ton of rock stamped, pounds.....	20.98
Average yield of ingot copper per ton of rock stamped, pounds.....	14.87
Average cost per ton, stamping and washing.....	44.62
Total number of fathoms of ground broken in openings and stopes.....	55,402
Average number of fathoms of ground broken in openings and stopes.....	7,914 $\frac{1}{2}$
Average yield of mineral per fathom, pounds.....	375 $\frac{3}{4}$
Average yield of ingot copper, per fathom, pounds.....	266 $\frac{1}{2}$
Total construction account.....	\$122,193.54
Average annual construction account.....	17,456.22
Average annual profit (including improvements charged to construction account).....	60,789.38
Average annual profit, excluding items charged to construction account.....	45,525.80
Total dividends paid to date.....	140,000.00

The capital stock is \$1,000,000, divided into 40,000 shares, \$25.00 each, \$17.50 of which has been paid in. Business office, 76 Wall street, New York. Jos. E. Grey, President; J. Stanton, Secretary; J. M. Mills, Treasurer; Wm. Tonkin, Agent; Capt. Peter Floyd, Mining Captain; B. C. McKeyes, Clerk.

#### THE HURON COPPER MINING COMPANY.

This company, it will be remembered, was organized in 1880 with a capital stock of \$1,000,000, divided into 40,000 shares.

The Huron is an old mine, first opened in 1855, and represents one of those unfortunate locations with which the copper region is too familiar. In reopening the mine and resuming operations upon this abandoned property, the management has proceeded cautiously; evidently they want to ascertain the value of the mine first, and not to expend any more upon the surface than is unavoidably necessary to carry forward the underground work, the main purpose being to push the openings.

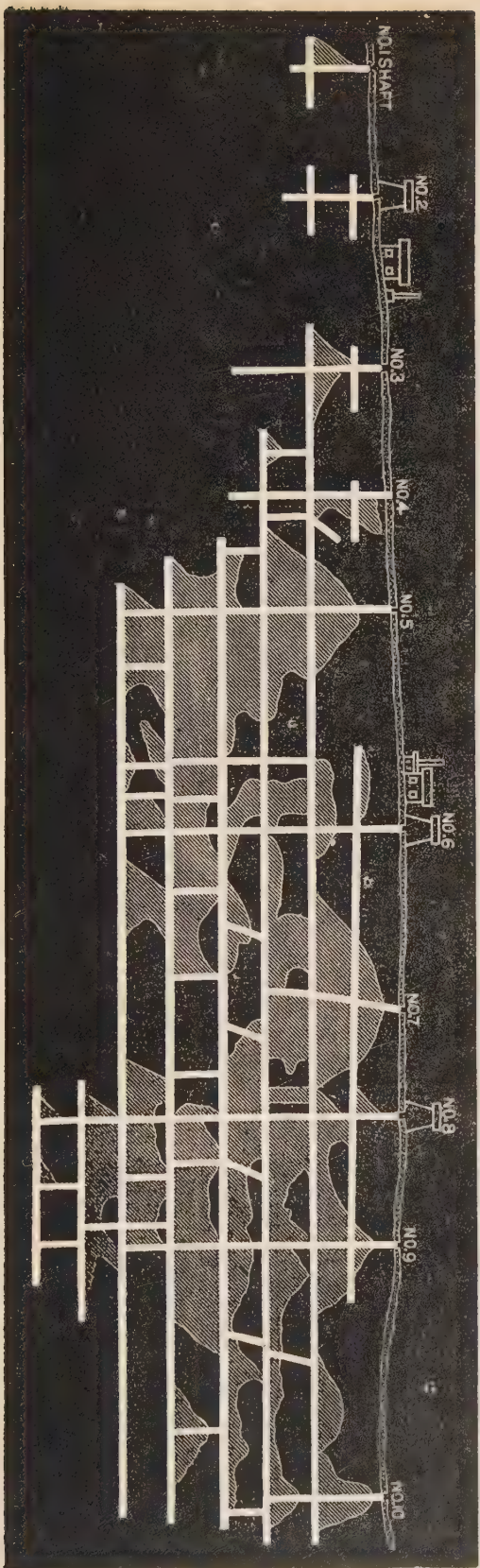
Two shafts are working, No. 6 and No. 8, and a portion of last summer, No. 10 shaft was working also. No. 6 shaft is to the 8th level and No. 8 to the 9th. All the shafts have been provided with new skip-roads. A new engine house has been built and furnished with new engine, 26 inch cylinder; also friction gear, hoisting machinery for No. 6 and No. 8 shafts have been provided. An engine, 10-inch cylinder, hoisting machinery—friction gear—have been erected to operate No. 10 shaft. This shaft is down to the 5th level. A new pumping engine—16 inch cylinder—has also been provided.

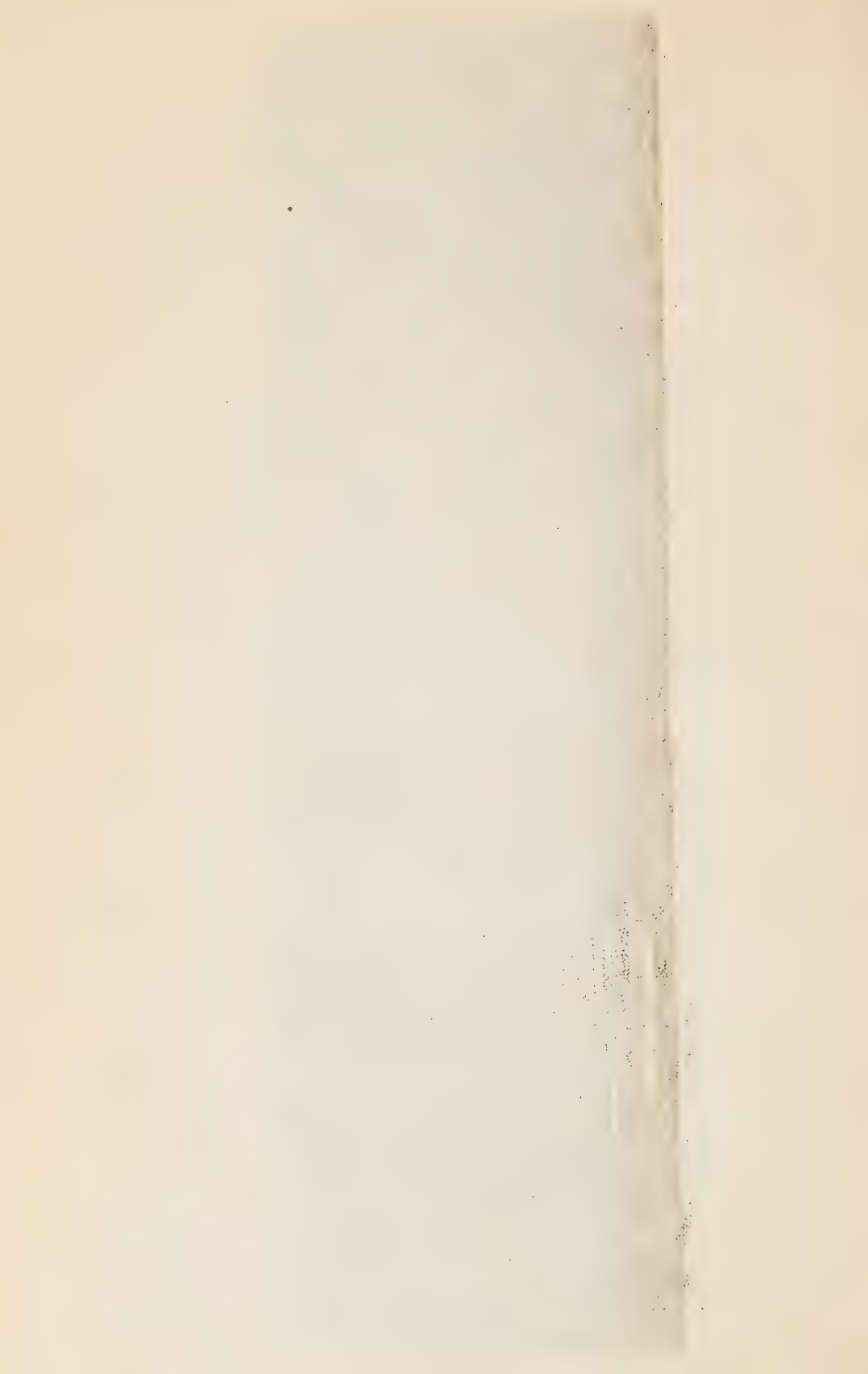
Five years ago, while the mine was run on tribute, a water wheel was built at the mill to run the stamp and other machinery. The wheel is 30 ft. diam-

\*In computing this total and the three averages following it we have increased the tons of rock stamped in years previous to 1880 at the rate of one ton for each car sent to mill.

# LONGITUDINAL SECTION OF THE HURON MINE.

Scale, 300 ft. to one inch.







eter and  $3\frac{1}{4}$  ft. breast. The company repaired this mill and operated it during seven months of the past year, using the water wheel to furnish the requisite power. The mill shut down in November last, owing to some breakage in the driving gear, and repairs not having been made the mill has since been idle. They operated four batteries—sixteen stamps—Gates pattern. Since the mill stopped the rock has been transported to the Pewabic mill.

To increase the water, a ditch has been recently made one and a fourth miles long to a branch of the Pilgrim river. The water is drawn from the dam to the mill in a race 2,000 feet long. The mill will work up about 700 tons per month. As now selected the rock yields about 3.5%.

The company has employed on an average 111 men, and has obtained 298,153 lbs. of mineral.

The number of feet of shafting sunk is.....	369
The number of feet of winzes sunk is.....	383
The number of feet of drifting done is.....	1,052
The number of fathoms stoped is.....	532
All the ground broken in the mine, estimated in cubic fathoms, amounts to.....	862
The total amount expended during the year.....	\$83,707.04

The general office is No. 4 Exchange street, Boston. D. L. Demmon, Secretary and Treasurer; Johnson Vivian, Agent, Houghton.

The description of the property is: S.  $\frac{1}{2}$  Secs. 1 and 2, T. 54, R. 34, lying south of the Isle Royal and north of the Atlantic.

The following report of Agent Vivian will give all the mining details.

I submit the following report of the operations at this mine for the year ending December 31, 1881:

#### SURFACE.

To protect the dam from injury during the spring freshets, it was necessary that considerable work should be done on it. Last spring the creek got so high that it threatened the destruction of a large portion of its bank. To prevent a recurrence of the like, we have taken out a large amount of timber that was used in its construction which was badly decayed, and substituted therefor clay and gravel. We have raised a portion of it. The water ditch from the dam has been extended a little over a mile, where it intersects another creek, which has greatly increased the amount of water that runs into the reservoir.

From April 15, last, to December 31, we ran from 10 to 12 heads of stamps with water power, which treated all the stamp rock taken from the openings and a few trial stopes.

We have commenced repairing a portion of the mill, and shall have 16 heads of stamps ready for use by the 1st of April; and, if we get the amount of water from the new ditch that we expect, we shall be able to treat about double the amount of rock that we did last summer, thus admitting a corresponding increase in the product. For about three months during the winter we shall stamp at the Pewabic mill.

Additions to Nos. 6, 8, and 10 shaft houses have been put on to facilitate the handling of timber that is sent into the mine, and assorting the rock that is taken out, etc.

#### MACHINERY.

All of our machinery, except the stamp mill, is in good running order. It may be necessary to put in a new foundation to the pumping engine next summer, which is only a short job.

We have purchased a diamond drill to explore some of the many lodes that run through this property. Two—the conglomerate and epidote—lodes were found between two and three hundred feet below the surface, in boring two holes about 600 feet apart. Both of these lodes contain copper, but not enough has been found to pay for working.

We have stopped operations with the drill for the winter, but as soon as the weather permits we shall start to bore again.

#### MINING WORK.

No. 8 shaft has been drained of water from the 5th to the 8th level, and sunk from the 8th to the 9th level. A winze, 60 feet south of the shaft, has been sunk to the 9th level. Both of these openings passed through a large lode, which contains a very fair amount of stamp and barrel copper; and some parts of the ground exposed are rich in stamp and barrel mineral. The old skip road, which was in very bad condition, has been taken out from the 3d to the 8th level and a new one put in; this was a very expensive piece of work.

The 9th level has been opened 50 feet; the lode at this point is showing some good stamp rock.

The 8th level has been extended north 100 feet; the lode in this opening is poor. The 7th level has been opened north 25 feet, and a winze sunk 25 feet to connect with a stope in the back of the level below, which has laid open a good little bunch of stamp copper. The 6th level has been opened north of this, No. 8 shaft, and connected with the drift from No. 6 shaft; in this back there is a rich piece of ground exposed for about 100 feet in length.

No. 10 shaft has been sunk from the 4th to the 6th level. The lode in this shaft from time to time showed some fair copper ground, but on the whole is rather lean.

The 6th level at this shaft has been opened south 10 feet and north 30 feet, all of which is very poor. The 5th level has been opened south 135 feet. The lode at this point is large enough, but too lean to pay for stoping. In a winze sunk from the 4th level, and connected with this drift, some good paying ground was found, which has been taken out. The 4th level has been extended south 165 feet, mostly through ground too poor to stope. The 2d level has also been extended south 87 feet, through very barren ground.

For the present we have discontinued all operations in this part of the mine, except opening the 6th level north, to connect with the old workings. When circumstances will permit, I would advise opening south of this shaft at a deeper level, where we should, I think, find some paying ground.

No. 1 shaft has been enlarged from the 6th to the 7th level, and sunk 35 feet below the latter. The lode, on the whole, in this opening is poor, but in the last few feet sunk there is some improvement, and it seems to be getting into a run of ground that will pay to stope.

The 7th level has been opened north of this shaft 120 feet, and south 121 feet. The lode in these openings contains more or less copper the entire distance. In some places it is quite rich in stamp copper. A winze north 95 feet and one 100 feet south of this shaft has been sunk from the 6th level and connected with the level below. The ground exposed in both of these openings is showing considerable stamp mineral and will pay to stope.

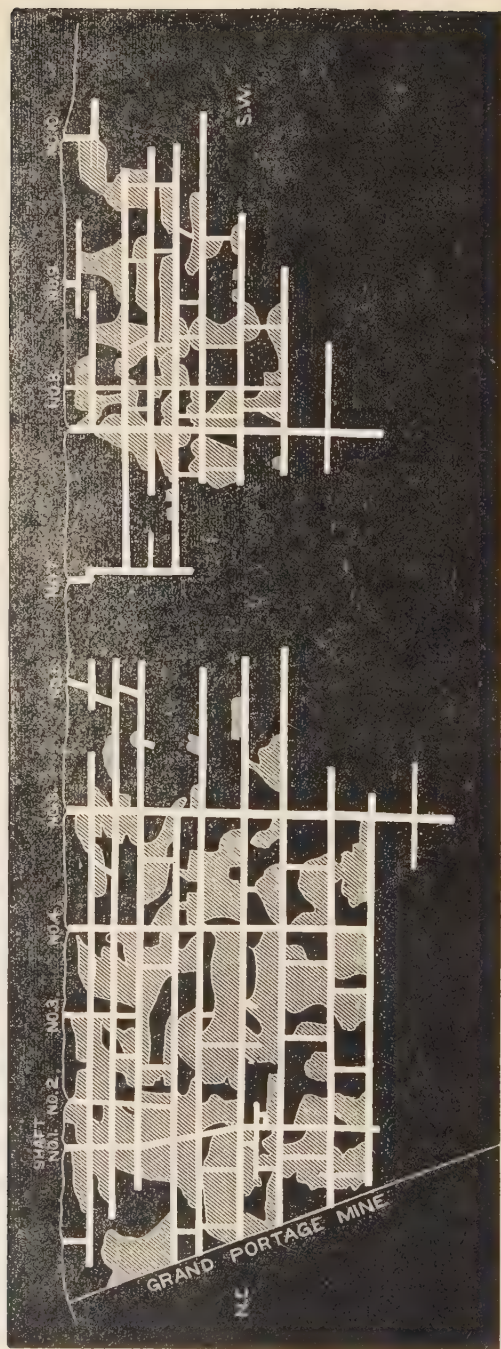
#### FUTURE PROSPECTS.

I regard the prospects for the future as very encouraging indeed; for when we take into account the fact that the yield of mineral per fathom of ground



# LONGITUDINAL SECTION OF THE ISLE ROYAL MINE.

Scale, 300 ft. to one inch.





broken is 344 pounds (keeping in mind the bad and the good ground that was opened), the result will compare very favorably with other mines in this district that are now making fair profits. There is no doubt in my mind concerning the success of the Huron. With suitable machinery, such as the compressor, power drills and a good stamp mill, all of which will only cost a moderate sum, it would soon be numbered among the paying mines of this region.

For further information in relation to our business, I beg leave to refer you to the clerk's report, and the section of the mine, which is marked up to this date.

Capt. T. H. Odgers, who is in charge of the mining department, has taken pains to promote the best interests of the company.

I am, yours respectfully,

J. VIVIAN.

#### ISLE ROYAL.

Adjoining the Huron on the north is the Isle Royal mine, which is another old and heretofore unfortunate concern.

Since 1870 the mine has been worked only on tribute, and is now filled to the 2d level with water. It is the same lode that is worked at the Huron, the Grand Portage, and the Sheldon and Columbian. It bears northeast  $62^{\circ}$ , and dips to the northwest at an angle of about  $45^{\circ}$ ; it has a width of 15 feet to 20 feet, and has rich pockets or bunches, but has a great deal of barren ground. The prevailing mineral is epidote. The belt is an amygdaloid.

Mr. Graham Pope, of Houghton, is agent for the property, and works a few miners in the two upper levels. Has had the past year 12 to 14 men. The rock is sorted very closely, so that it yields 8% to 9% copper. The product gotten out in 1881 is 38,380 pounds. Mr. Pope contemplates unwatering the north part of the mine so as to work it. He will do the pumping in company account, but mine, as now, on tribute. He thinks that the north part of the mine will afford some good ground. In the event of this plan being carried out, the machinery and the number of miners will be increased.

The property measures  $1\frac{1}{2}$  miles east and west and  $\frac{1}{2}$  mile north and south. The length of the lode on the property is about 3,000 feet. There are also several parallel lodes, one  $\frac{3}{4}$  of a mile to the east, called the Mabb's vein. This has been explored with pits, and one shaft was sunk to the 3d level and some drifting done. The estate comprises 420 acres, to wit: the N.  $\frac{1}{2}$  Sec. 1, T. 54, R. 34, and the N. W. fractional  $\frac{1}{4}$  Sec. 6, T. 54, R. 35.

Office in New York. Secretary and Treasurer, F. W. Chapin; Agent, Graham Pope, Houghton, Mich.

#### THE GRAND PORTAGE.

Lying next, to the north, is the Grand Portage, another of the south side mines, which has been the scene of repeated failure. The new company organized in 1880, with capital stock of \$500,000, divided into 20,000 shares, has pushed forward its work with considerable vigor. The company is working the two lodes in which the old mines were opened. The Portage Mine lies 200 feet to the west of the Isle Royal vein, measured on the surface, but the former dips at an angle of about  $45^{\circ}$ , while the latter dips at about  $35^{\circ}$ , so that the two veins tend to come together. Probably the Portage is the "mother" lode and caps the other. The east vein terminates to the north

against a wall of trap, and in the same manner the west vein ends to the south.

If faulted the parts were also shoved past each other longitudinally. The company is working one shaft in each vein. The one on the east vein is down about 290 feet to the 5th level; this is called No. 2. They are driving, in the 5th level, which was opened the past year, and Capt. Tallon deems it to be the best level yet opened in the mine.

They are also drifting north in the 2d, 3d, and 4th levels. In the 5th the drift extends north of the shaft about 20 feet, and to the south about 100 feet. The lode has an extreme width of 30 feet and gives about one-third waste; the copper makes along the foot and hanging, and tends to leave a bar in the center. The extreme length of the opening in this branch is 450 feet; in the west vein the extreme length of opening is 700 feet.

There are three shafts in each vein; in the west vein they are working in the 4th, 5th, and 6th levels, the latter having been sunk the past year. The lode is more regular than the other, but the copper makes along the foot and hanging in the same way. About one-half of the ground is left, and they endeavor to leave it without breaking. In some measure the waste rock that is broken is left behind the stulls in the mine. The lode is a series of bunches, which are connected by strips of vein rock.

In the 6th level, south of No. 2, occurred a portion of lode which for a distance of 150 feet was 40 feet wide; its width was determined by cross-cutting, and no trap bar was found, but it was not equally rich. This ground still continues.

The rock is all sorted except the fine in the bottom, which of course must be shoveled up as it comes. The hanging is good, giving a soft roof, pillars are left sufficiently frequent, and some lode matter next to the hanging to help support it. When the lode makes out it is invariably in the foot, and it is along the foot that the most copper is found. In making the openings the foot wall is taken as the guide. The company employ a total force of 125 men, about 45 of whom are miners.

The stoping costs, underhand, \$14 per fathom.

The stoping costs, breast, \$16 per fathom.

Stoping costs, raised, \$17 to \$18 per fathom, the work being done on contract, the men furnishing themselves.

The rock is removed on day work, company account.

Trammers receive \$35 per month.

Drifting, size of drifts, 5x6 feet, costs \$10 per foot.

Sinking shafts, 9x12 feet, costs \$25 per foot.

Sinking winzes, \$10 to \$15 per foot.

They have not treated the rock for a sufficient length of time to ascertain the yield per fathom or per ton. So far as treated at the new stamp mill the rock has given about 4 % of copper, but it has been well picked.

The mill is on the lake, on Main street, in Houghton, and was started the 22d of December, 1881, six batteries, 24 heads, similar to those in the Quincy mill. The mill is about 100 rods from the mine, and the rock is hauled to it with teams. Two teams now suffice for this work; each hauls 10 loads per day; as it is down hill and on sleighs they take large loads. The mill has 12 Shiermann washers, 1 slime table, 20 feet diameter, and a second one is building. The pump is a 10-inch Hodge. The engine is 18x36 feet, and drives everything in the mill. They are stamping 60 tons per day. The stamp could do more if the rock were broken finer.

There was a good deal to do. The shafts had to be lined up, and there is still very much to be done. The mine is deficient in machinery. There are two small engines to do the hoisting, each able to raise one ton at a time. They should have the power to bring up  $2\frac{1}{2}$  tons to a skip-load.

A tram road, a gravity incline, is needed from the mine to the mill; also a rock-house is needed, with a rock hammer, Blake's crushers, etc. Now the breaking is all hand work, of course imperfect and expensive.

With the mine well opened and the necessary improvements in machinery, etc., made, it is probable that the mine could be made a paying concern.

It certainly ought to include the Sheldon-Columbian Mine, lying between it and the lake; then the mine could be opened with an adit through which the water and product could be taken out, and the old Sheldon-Columbian stamp mill, still standing, is in a far better situation than the one the Portage Company have just built.

The officers of the company are not experienced in mining, but are business men in Hancock. They have in Capt. Tallon, however, a man who is familiar with the work, and who has many years ago worked in this mine, so that he knows from previous experience its peculiar features.

The officers are Joseph Worden, President; Peter Ruppe, Secretary and Treasurer; Michael Shubert, Superintendent stamp mill; M. L. Tallon, Mining Captain.

### THE QUINCY.

Taken all in all the Quincy has, perhaps, the best record of any copper mine on Lake Superior. It would, no doubt, be easy to successfully criticise many of the details of the management; but it is an old company, started in 1848, and there are few others, if any, that can show, for so long a period, such a uniform and consistent record. It has a very valuable history; a suggestive one to other companies. If any one mine were to be selected as an example from which to derive important lessons, undoubtedly the Quincy deserves the preference. Its management may be characterized as, on the whole, a fortunate medium between the conservative and progressive; it has ever held to that which has stood the test of experience, and availed itself of whatever was new that was proved to be of value.

It has experienced all the difficulties that have been encountered by other companies, and has equally met with good fortune. Not unfrequently in this, as in other mines, the copper has, to all appearances, been approaching exhaustion, but the company has never hesitated in such emergencies, but has held to its faith in the ultimate result, and pushing forward with undiminished vigor, has ever been rewarded by opening again into productive ground. The confidence which the management has shown in the mine has long ago extended to the public, and everywhere the substantial character of the Quincy is regarded. No reported exhaustion or leanness of the lode would suffice to impair people's confidence in the mine. The company has experienced too many such periods of depression, and having always passed through them unscathed, it is no matter of surprise that the Quincy should enjoy a reputation for solidity and permanency.

The chief peculiarity of the Quincy Mine has been that however unfavorable it may have sometimes appeared, it has always been found to recover its productiveness as the work has been pushed, so that the confidence in the lode has become so well established that though there may be occasional cause for



anxiety, there is never discouragement. The narrower and leaner the lode has become the greater the energy and vigor displayed in opening into new ground.

A sufficiently full statistical history of this important mine for each year of its working up to 1881 was given in the last commissioner's report, and it is not necessary to repeat any of its details.\* The following table, which summarizes the more important of these results for a period of 12 years, is taken from the Northwestern Mining Journal:

QUINCY MINING COMPANY.							
1870.	1871.	1872.	1873.	1874.	1875.		
Product of stamp copper.....	1,437 tons.	1,302 tons.	1,644½ tons.	1,752½ tons.	1,717½ tons.		
Product of mass copper.....	86 tons.	100 tons.	67½ tons.	68 tons.	46 tons.		
Total product, mineral.....	1,523 tons.	1,402 tons.	1,712 tons.	1,810½ tons.	1,763½ tons.		
Product of ingot copper.....	1,243½ tons.	1,134½ tons.	1,400 tons.	1,525½ tons.	1,399½ tons.		
Percentage of mineral.....	84.48	79.76	81.12	81.90	82		
Gross earnings.....	\$538,170 00	\$549,780 00	\$725,067 00	\$722,409 00	\$653,168 08		
Total expenses.....	382,710 00	355,513 00	522,107 00†	519,903 00†	456,816 68		
Per cent of expenses to earnings.....	71.11	64.49	71.99†	71.97†	69.93		
Dividends paid.....	\$157,630 00*	193,377 00*	213,544 00*	\$174,472 00*	2216,964 00		
Net profit.....	80,000 00	280,000 90	250,900 00	160,000 00	160,000 00		
Surplus undivided.....	265,533 00	297,742 00	265,103 00	313,572 00	385,009 00		
Total mining cost of ingot copper per pound.....	12.43	13.22	20.26†	16.28†	13.37		
Smelting, marketing, and other expenses per pound.....	2.47	2.38	2.67	2.29	2.42		
Average cost per pound, marketed.....	14.90	16.60	22.93†	18.57†	15.79		
Average sales of ingot copper per pound.....	21.00	23.50	32½	26.50	22.67		
Tons of rock stamped.....	55,027	59,757	60,838	63,272	70,501		
Average per cent of mineral in stamp rock.....	2.61	2.59	2.14	2.60	2.44		
Stamp mill in operation.....	283 days.	292½ days.	283 days.	293 days.	278 days.		
Cost per ton, stamping and washing.....	\$2 45	\$1 01	\$1 06½	\$1 21	96½		
Number of fathoms stoped on contract.....	4,273	4,692	5,165	4,946	4,963		
Yield of mineral, per fathom.....	624 lbs.	551 lbs.	482 lbs.	600 lbs.	591 lbs.		
Yield of ingot copper, per fathom.....	538 lbs.	411 lbs.	391 lbs.	491 lbs.	485 lbs.		
Average force employed.....	422 men.	410 men.	437 men.	489 men.	403 men.		
Average number of miners.....	181 men.	194 men.	233 men.	223 men.	271 men.		
Average wages of miners on contract, per month.....	\$19 69	\$17 08	\$20 62	\$22 92	\$18 38		

\* This includes \$4,323, being 15 per cent, received in settlement with Holmes & Lissberger for \$28,820 of copper sold them in 1874, and charged off in the accounts of that year.

† Including interest on loans, \$2,169.26 in 1870; \$10,160.56 in 1871; \$10,422.67 in 1872; \$2,725.32 in 1873; \$4,432.30 in 1874.

‡ \$67,227.65 "extraordinary expenses" in 1872, and \$35,492.46 in 1873.

§ The \$28,820 "for copper delivered Holmes & Lissberger, bankrupts," is deducted.



QUINCY MINING COMPANY.					
	1876.	1877.	1878.	1879.	1880.
Product of stamp copper.....	1,765½ tons.	1,586½ tons.	1,694½ tons.	1,608 tons.	2,355½ tons.
Product of mass copper.....	65½ tons.	65½ tons.	70½ tons.	59½ tons.	83½ tons.
Total product, mineral.....	1,830½ tons.	1,652½ tons.	1,764½ tons.	1,667½ tons.	2,439½ tons.
Product of ingot copper.....	1,536½ tons.	1,427½ tons.	1,434½ tons.	1,392 tons.	1,845½ tons.
Percentage of mineral.....	80.53	82.23	81.18	83½	83½
Gross earnings.....	\$581,226 66	\$515,584 00	\$447,510 00	\$457,604 00	\$755,694 00
Total expenses.....	461,032 43	421,874 00	401,849 00	385,064 00	451,652 00
Per cent of expenses to earnings.....	79.32	81.05	87.88	83.49	63.73
Net profit.....	120,194 18	93,710 01	55,340 38	75,541 00	347,154 00
Dividends paid.....	140,000 00	80,000 00	40,000 00	40,000 00	6220,000 00
Surplus undivided.....	331,299 11	364,685 85	380,026 00	455,567 70	6582,722 00
Total mining cost of ingot copper per pound.....	13.33	12.81	11.88	11.62	10.01
Smelting, marketing, and other expenses per pound.....	2.39	2.80	2.13	2.09	1.80
Average cost per pound, marketed.....	15.72	15.11	14.01	13.71	11.81
Average sales of ingot copper, per pound.....	20	18.56	14.01	16.32	18.51
Tons of rock stamped.....	74,717	75,307	92,860	89,817	84,426
Average per cent of mineral in stamp rock.....	2.38	2.11	1.76	1.85½	2.79
Stamp mill in operation.....	280 days.	266 days.	281 days.	281½ days.	255 days.
Cost per ton, stamping and washing.....	91	694.80	765.53	695	778.83
Number of fathoms stamped on contract.....	4,796	4,729	7,220½	6,919	7,243½
Yield of mineral per fathom.....	629 lbs.	568 lbs.	472 lbs.	483 lbs.	673 lbs.
Yield of ingot copper per per fathom.....	507 lbs.	467 lbs.	397 lbs.	403 lbs.	563 lbs.
Average force employed.....	510 men.	474 men.	490 men.	481 men.	492 men.
Average number of miners.....	271 men.	249 men.	234 men.	212 men.	192 men.
Average wages of miners on contract, per month.....	\$47 13	\$43 79	\$41 50	\$38 76	\$49 10

*f* 17.83 cents per ton for repairs.

*g* 17.74 cents per ton for repairs.

*h* 22.36 cents per ton for repairs.

*i* From which deduct dividend of Feb. 20, 1882; \$350,000.

*b* 29.50 cents of this was for repairs on mill.

*d* Includes stock dividend, Sept. 1, 1880; \$100,000.

*e* From which deduct dividend of \$200,000 paid Aug. 1, 1881; and dividend of

\$120,000, Aug. 22, 1881.

QUINCY MINING COMPANY.

1881.

3,096½ tons.  
3,14½ tons.  
3,407½ tons.  
2,851½ tons.  
83.73  
\$1,044,610 00  
572,008 00  
472,591 00  
320,069 00  
4735,313 00  
7.83  
2.20  
10.03  
18.17  
98,869  
3.13

1880.

2,355½ tons.  
83½ tons.  
2,439½ tons.  
1,845½ tons.  
83½  
\$755,694 00  
451,652 00  
347,154 00  
6220,000 00  
6582,722 00  
10.01  
1.80  
11.81  
18.51  
84,426  
2.79  
255 days.  
778.83

1879.

1,608 tons.  
59½ tons.  
1,667½ tons.  
1,392 tons.  
83½  
\$457,604 00  
385,064 00  
75,541 00  
40,000 00  
455,567 70  
11.62  
2.09  
13.71  
16.32  
89,817  
281½ days.  
695

1878.

1,694½ tons.  
70½ tons.  
1,764½ tons.  
1,434½ tons.  
81.18  
\$447,510 00  
401,849 00  
55,340 38  
40,000 00  
380,026 00  
11.88  
2.13  
14.01  
92,860  
1.76  
281 days.  
765.53

1877.

1,586½ tons.  
65½ tons.  
1,652½ tons.  
1,427½ tons.  
82.23  
\$515,584 00  
421,874 00  
93,710 01  
80,000 00  
364,685 85  
12.81  
2.80  
15.11  
18.56  
75,307  
2.11  
266 days.  
694.80

1876.

1,765½ tons.  
65½ tons.  
1,830½ tons.  
1,536½ tons.  
80.53  
\$581,226 66  
461,032 43  
79.32  
120,194 18  
140,000 00  
331,299 11  
13.33  
2.39  
15.72  
20  
74,717  
2.38  
280 days.  
91

Product of stamp copper.....  
Product of mass copper.....  
Total product, mineral.....  
Product of ingot copper.....  
Percentage of mineral.....  
Gross earnings.....  
Total expenses.....  
Per cent of expenses to earnings.....  
Net profit.....  
Dividends paid.....  
Surplus undivided.....  
Total mining cost of ingot copper per pound.....  
Smelting, marketing, and other expenses per pound.....  
Average cost per pound, marketed.....  
Average sales of ingot copper, per pound.....  
Tons of rock stamped.....  
Average per cent of mineral in stamp rock.....  
Stamp mill in operation.....  
Cost per ton, stamping and washing.....  
Number of fathoms stamped on contract.....  
Yield of mineral per fathom.....  
Yield of ingot copper per per fathom.....  
Average force employed.....  
Average number of miners.....  
Average wages of miners on contract, per month.....

*b* 29.50 cents of this was for repairs on mill.

*d* Includes stock dividend, Sept. 1, 1880; \$100,000.

*e* From which deduct dividend of \$200,000 paid Aug. 1, 1881; and dividend of

\$120,000, Aug. 22, 1881.

The Pewabic lode, as developed in the Quincy, is a broad belt, 200 or more feet in width, through which runs a bunchy deposit, or a series of connected deposits of amygdaloid; laterally, in the foot, and hanging, are also pockets of amygdaloid, which, when worked, are reached by cross-cuts from the main drifts. Altogether these make up the belt. The main lode is tolerably well defined and is followed, and the diamond drill, which for years has been employed in the mine, discovers the lateral pockets, many of which prove greatly productive in copper. They are sometimes in the foot, and as frequently in the hanging side. Nearly 300 borings have been made in the mine with the diamond drill, having an average length of 120 feet. These explorations have been made chiefly in the 60th, 70th, 160th and 180th levels, and from the latter down to the bottom of the mine, more or less in every level, but a greater number in the 230th, 240th, 250th, and 260th levels. The mine has been explored in this way, from north to south, 1,700 feet, and to a width of from 200 feet to 400 feet.

These holes are all mapped and the character of the ground gone through in each is clearly indicated, so that the mining captain can thus be guided in laying out his cross-cuts.

The Quincy affords an excellent example of the value of the use of the diamond drill in the prosecution of mining work. Most of the copper is now coming from the 180th, south, and in the north end from the 180th down, and in the bottom, that is in the lowest two levels, 270th and 280th—though they are down to the 290th, and during the coming year, 1882, will sink to the 300th. The depth of the mine on the inclination of the lode,  $56^{\circ}$  with the horizon, is 2,200 feet. It is also expected that 6,000 feet of ground will be opened. The hoisting is done from No. 2 and No. 4 shafts, and the product is run by an automatic railway, wire rope transmission, to the rock house, which latter stands at the head of the incline, double track, gravity railroad that runs to the stamp mill.

The automatic railway is 1,465 feet in length, and the gravity incline is 2,200 feet long; two loaded cars go down at a time, each carrying 2 tons of rock, and two empty cars ascend, drawn up by the descending ones.

In February, 1881, Mr. A. J. Corey, who for the period of 10 years had been agent of the Quincy, and who, prior to that, had served as clerk, died very suddenly. Mr. Corey was esteemed as an unusually intelligent and energetic mining agent, and was highly regarded by the company and by the people, among whom he had for so long a time dwelt.

The company was very fortunate, however, in being able to repair the loss occasioned by the death of this very capable and faithful officer, in securing the services of Mr. Frank G. White to fill the place thus made vacant. Mr. White has heretofore been agent of several of the leading mines on the lake—the Ridge, Phoenix, Osceola, etc., and is known to be a thoroughly qualified agent, and withal a genial, popular gentleman. Under his management the Quincy is sure to continue to be intelligently looked after.

The company for the past two years has been unusually prosperous. The increase is shown in the following table. In 1879 the product was 1,323 2-3 tons; in 1880, 1,848 1-8 tons; in 1881, 2,753 1-2 tons.

The per cent of yield of copper from the rock stamped for each year is given in the Commissioner's Report, 1880, and the table is herewith copied with the year 1881 added:

Year.	Per cent.	Year.	Per cent.	Year.	Per cent.
1861.....	2.55	1868.....	2.25	1875.....	2.44
1862.....	2.03	1869.....	2.48	1876.....	2.38
1863.....	2.75	1870.....	2.61	1877.....	2.11
1864.....	2.96	1871.....	2.29	1878.....	1.76
1865.....	2.60	1872.....	2.17	1879.....	1.80
1866.....	2.63	1873.....	2.60	1880.....	2.50
1867.....	2.74	1874.....	2.61	1881.....	3.13

The yield of copper per fathom of ground broken in the mine, the past year, was nearly twice as great as it has been in many former years, 767 pounds. In 1877, for instance, it was 467 pounds.

In the mine are 20 batteries—80 stamps. This mill has heretofore had a high reputation, and was, until recently, considered to be the most economically worked mill on the lake; but whatever its merits, the figures of cost of working are against it, as shown by the following:

Quincy mill, cost for stamping per ton of rock stamped, 72 3-10 cents.

Osceola mill, cost for stamping per ton of rock, 44 cents.

Atlantic mill, cost for stamping, etc., per ton of rock, 42½ cents.

The Quincy rock should be treated as cheaply as the Osceola or the Atlantic. To all appearances there should be no difference in working it in the stamp mill. On such an assumption there should be a saving of 28 to 30 cents per ton, as shown in the foregoing comparison, on the present cost of treating the rock, which applied to 100,000 tons, the amount treated annually in the mill, would result in a yearly saving of \$30,000 to the company.

On the other hand Mr. Corey and those who favored the use of the stamps now employed in the Quincy mill claimed that there is otherwise a saving that compensates for the increased cost of stamping. Average assays of the waste sands from the Quincy stamps show, it is said, a very small loss as compared to the tailings from the Ball stamps. For instance, in 1879, the loss was only 185-1000 of one per cent at the Quincy Mine.

Notwithstanding, the change to Ball stamps is seriously contemplated, and would no doubt be an important pecuniary advantage to the company.

About 80 % of the rock mined is stamped; the remaining 20 % is either left in the mine or rejected after hoisting. The following summary will be of value:

No. of tons of rock broken in the mine but not hoisted, 1,509.

Cost per ton for mining rock, including all rock broken.....	\$3 53
Cost per ton, embracing only the rock which was hoisted, but compared to the same aggregate cost as the above.....	4 01
Cost per ton including only the rock stamped, but compared to total expenses, as the above.....	4 51
In the same manner the total construction expenses per ton of rock mined.....	53
Total construction expenses per ton of rock hoisted.....	60
Total construction expenses per ton of rock stamped.....	67½
Total cost per ton for stamping, etc., per ton of rock hoisted.....	56 7-10
Total cost per ton for stamping, etc., per ton of rock stamped.....	72 3-10
Mining expenses, including cost of mining, tramming, hoisting, etc., etc., apportioned, per ton of rock mined.....	2 14
Total mining expenses apportioned per ton of rock hoisted.....	2 43
Total mining expenses apportioned per ton of rock stamped.....	2 73

The average price paid per foot for driving drifts, 6 feet by 7 feet, has been.....	\$10 25
Average per fathom for stoping.....	15 82

Further statistics will be found in the subjoined report of the company for 1881.

Since 1878, the date of the company's reorganization, the capital stock has been \$1,000,000, divided into 40,000 shares.

The officers are Thomas F. Mason, President; Wm. R. Todd, Secretary and Treasurer, No. 4, Exchange street, New York. Frank G. White, Agent, Hancock, Mich.

The latest quotations of stock in the Boston market, \$54 per share.

#### REPORT OF QUINCY MINING COMPANY FOR THE YEAR 1881.

The directors submit the following report of the business of the mine for the past year, and statement of the financial condition of the company:

The shipment of the season was 6,576,755 pounds of mineral, which has been smelted and yielded about 83 73-100 per cent, or 5,503,848 pounds of refined copper.

The product of the mine for the year, as prepared for shipment, was 6,815,485 pounds, or 3,407 1485-2000 tons of mineral, of the following descriptions, namely:

	Pounds.
Stamp copper.....	6,193,190
Mass copper.....	622,295
	<hr/> 6,815,485

for which, estimating December product at 82 per cent yield, and 20 cents per pound, has been realized the

Gross sum of.....	\$1,036,175 90
Realized from sale of silver.....	2,280 94
	<hr/> \$1,038,456 84

The expenses of the year are as follows:

Running expenses at mine.....	\$379,326 17
Building and construction account.....	66,673 86
Smelting, transportation, and all other expenses.....	126,018 42
	<hr/> \$572,018 45
Which, deducted from gross earnings.....	1,038,456 84
leaves as mining profit.....	\$466,438 39
There has also been realized during the year from interest.....	6,153 36
	<hr/> \$472,591 75

The statement of assets and liabilities in our last report showed a balance on hand, as of date

January 1, 1881.....	\$582,722 04
Add earnings of 1881.....	472,591 75
	<hr/> \$1,055,313 79
Deduct dividend of February 15, 1881.....	\$200,000
Deduct dividend of August 22, 1881.....	120,000
	<hr/> 320,000 00
Making balance of assets Jan. 1, 1882.....	\$735,313 79



A dividend of \$8 per share, or \$320,000, payable February 20, has been declared, which, with dividend of \$3 per share, paid August 22 last, makes total for the year \$440,000.

During the past year it has been deemed advisable to introduce 12 additional power drills, and to construct water works to supply the mine engines with water, and for use in case of fire, and for other purposes. These expenditures, together with the purchase of one of Rand's duplex air compressors for driving the drills, the erection of a building for the compressor, new machine shop, shaft house, warehouse addition, sand wheel and building, with the completion of the dwelling for the mine agent's residence, have added largely to the construction expense; but the additions thus made to the mine plant will, we believe, furnish facilities for maintaining our increased production, with fewer miners than it would otherwise have been necessary to employ.

Below we present the Treasurer's statements, and the annual report of Mr. F. G. White, agent at the mine. All of which is respectfully submitted.

THOMAS F. MASON, *President*.

NEW YORK, February 20, 1882.

GENERAL SUMMARY OF RECEIPTS AND EXPENDITURES OF THE QUINCY MINING COMPANY, FROM ITS ORGANIZATION TO DECEMBER 31, 1881.

EXPENDITURES.

For expenditure on location previous to 1856.....	\$42,097 98
For expenditure on Quincy vein in 1858, not now worked.....	55,000 00
For openings and explorations on 3,800 feet "east" or Pewabic vein, extending to Portage Lake, preparatory to future work.....	11,500 00
For real estate and permanent improvements on same, including dwelling houses, stamp mill, machinery, steam engines, tram road, dock, warehouses, and other buildings and roads.....	788,116 20
For mining and surface labor, expense of smelting and marketing copper, and all incidental expenses.....	9,673,294 10
Balance carried down.....	3,545,313 79
	<hr/> \$14,115,322 07

RECEIPTS.

From capital stock paid in.....	\$200,000 00
" proceeds copper and silver (59,560,041 pounds copper).....	13,709,685 61
" interest.....	88,313 39
" profit on sale of P. L. & R. Improvement Company stock, and other investments.....	70,316 39
" sales of real estate, Hancock.....	47,006 68
	<hr/> \$14,115,322 07
By balance brought down, being receipts over expenditures.....	\$3,545,313 79
Deducting dividends declared, Nos. 1 to 26 inclusive.....	2,810,000 00
	<hr/> \$735,313 79
Leaving balance, as per statement in detail.....	

STATEMENT OF ASSETS AND LIABILITIES, EXCLUSIVE OF REAL ESTATE, MINE PLANT AND SUPPLIES IN USE, JANUARY 1, 1882.

ASSETS.

Loans on call.....	\$241,500 00
Cash in bank.....	1,435 77
Cash on hand at mine.....	4,807 37
Copper on hand (unsold, estimated at 20c per pound).....	449,578 40
Accounts receivable, (since paid).....	24,064 44
Bond of Mineral Range R. R. Co., \$13,000, at 50 per cent.....	6,500 00
Company's stock, costing.....	342 00
	<hr/> \$728,227 98

## LIABILITIES.

Drafts unpaid.....	\$394 22	
Dividends unpaid.....	3,190 00	
Accounts payable in N. Y.....	23,000 00	
Accounts payable at mine.....	52,557 82	79,142 04
Balance available assets.....		\$649,085 94
Add at mine, supplies per inventory on file.....	\$69,529 02	
Farm account (horses, wagons, etc.).....	13,937 47	
Accounts receivable.....	2,761 36	86,227 85
Total balance assets.....		\$735,313 79
Less dividend payable February 20, 1882, \$8 per share, or \$320,000.		

## SUMMARY FOR THE YEAR.

Average force employed.....	486 men.
“ number of miners.....	212 “
“ wages of miners on contract per month.....	\$48 54
Yield of mineral per fathom of ground broken.....	918 lbs.
“ “ refined copper per fathom of ground broken.....	767 “
Total rock mined.....	126,140 tons.
“ “ hoisted.....	111,131 “
“ stamp rock treated.....	98,869 “
Yield of stamp rock treated (3 13-100 per cent).....	6,193,190 lbs.
Product mineral.....	6,815,485 “
“ refined copper.....	5,702,606 “

## AGENT'S REPORT.

QUINCY MINE, MICH., }  
 January 1, 1882. }

After the sudden death of Mr. Corey, your late superintendent, you placed the local management in my hands, and it now affords me great pleasure to testify to the general good condition in and about the mine, and to the fact that the results of the past year are largely due to his labor, and the good judgment exercised by him.

The underground work has progressed favorably during the year, while the product has been exceptionally large as compared with former years. The continuance of the rich stope which proved so productive in the twenty-fourth and twenty-fifth levels has more than equalled expectations and still promises well in the twenty-seventh level. This stope produced largely in the later months of the year. All the levels below the nineteenth and several above the thirteenth have contributed to make up the product, and from the eighteenth, nineteenth, twenty-first, twenty-second, twenty-fourth, twenty-fifth, twenty-sixth, twenty-seventh, and twenty-eighth, we expect continued good yield.

The eighteenth level has been extended to a point 1,120 feet from No. 4 shaft, the most southern point reached by any level in the mine openings, and is now in copper. As this is new ground, the back being intact to surface, developments here will be of great value should the copper continue.

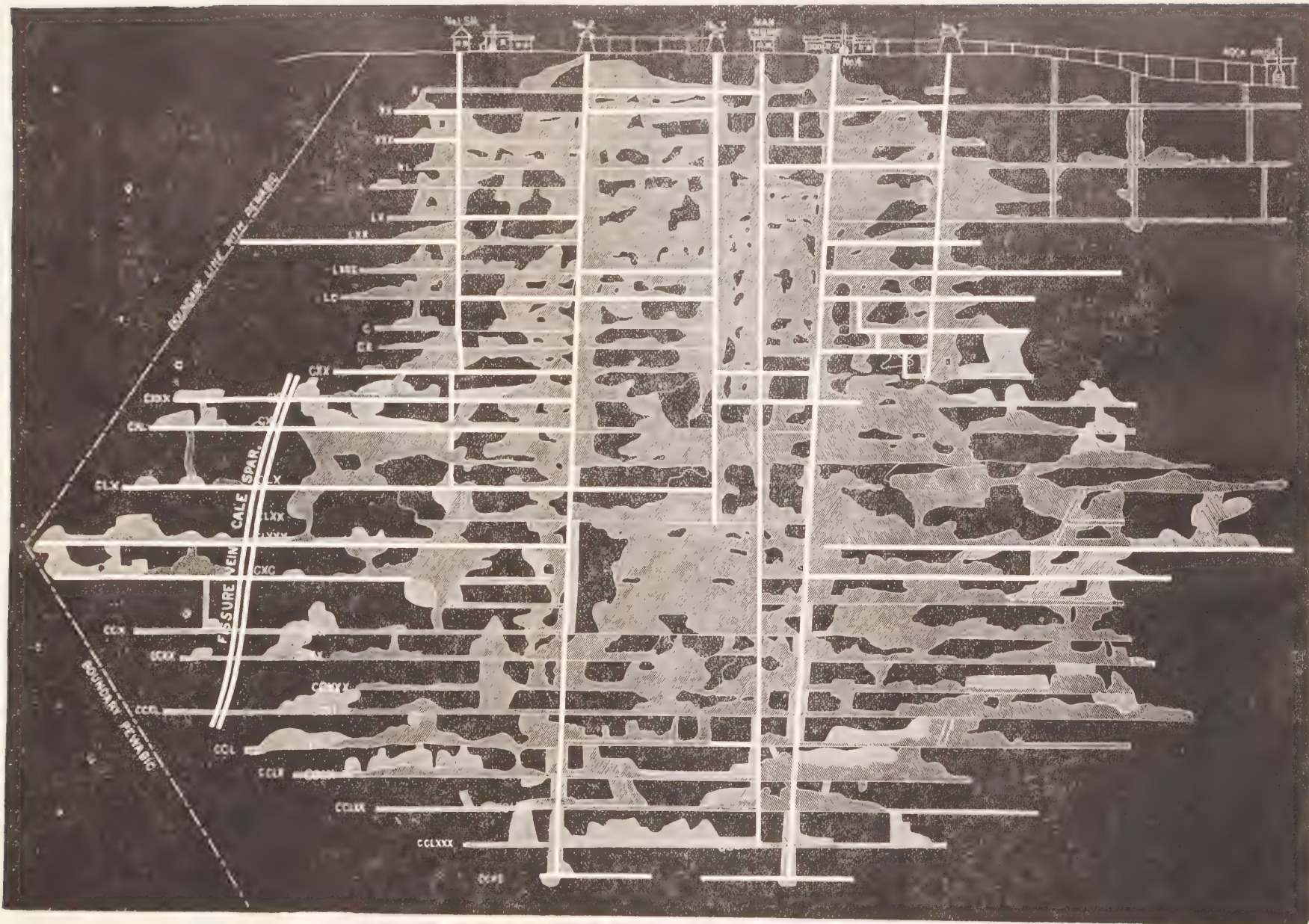
During the coming year we expect to sink both shafts to the thirtieth level, and extend, as rapidly as can be done by use of power drills, all the levels below the nineteenth, north of No. 2 shaft, and as many as developments warrant south of No. 4 shaft.

The use of the diamond drill was discontinued in March last, the old compressor being unable to furnish sufficient air to run that and other power drills. The result has justified this course, but we soon expect to again resume its use.



LONGITUDINAL SECTION OF THE QUINCY MINE, JAN., 1882.

Scale, 300 ft. to one inch.







In June last we decided to put in use additional Rand drills, also to procure a Rand compressor to supply the requisite power, the old compressor proving inadequate. A stone building was erected in which to place the compressor and the pumping engine, and to furnish room for a machine shop, for which we have procured the necessary tools for doing repair work.

During the past several winters it has been necessary to melt snow to provide water for steam purposes; and considering the expense and the uncertainty involved, and the damage which would result from total failure of a supply of water, a pump was purchased and placed at the mill, and a line of iron pipe laid, leading from the lake to a cistern at the mine, to supply the lack of water needed for steam and other purposes; and, after several months' use we find it to work satisfactorily in every way.

No changes have been made in hoisting and steam equipment, except the placing of a stone foundation under No. 2 engine, the material and plans having been procured by the late Mr. Corey. For economy, it will soon be necessary to consider the question of a new engine at No. 2 shaft, as the present engine will be inadequate to the demands. No time should be lost in giving our steam equipment full consideration. Quite a number of the boilers have been in use over twenty years, and all are old and require frequent repairs, involving us in great liability to accident, as well as, under present circumstances, being far from economical. I would strongly recommend an early attention to this question.

At the stamp mill we found it a necessity to build a new sand wheel with a building, also a new tailing house. The new wheel is of much larger diameter, to enable us to elevate the waste sand to a point which commands a much larger area for its deposit. We will be called upon to incur quite an expense during the next few years in improving the dock front around the accumulated waste sand, to enable us to continue to run it into the bay. Work should be commenced this season to provide, also, facilities for handling coal for steam and fuel purposes at the mine, which will be needed within three years, as no timber will then be near enough to the mine to allow of its use as fuel, as compared with the cost of coal.

The stamp mill has given good results for the year. It was under repairs during the latter part of last April and early in May, being idle fourteen days. The cost of stamping has been somewhat less than the year previous, and cost for repairs also less, but other expenses have been about the same. We have, however, been unable to obtain as low a rate of cost in stamping as have other mines in treating similar rock. The mine is equal to supplying a large quantity of low grade rock in addition to what is now treated, and which should be mined and milled with the higher grades which have been stamped during the past two years; but the mill having been worked to its full capacity, no increased duty was possible.

The usual statements and tables, giving the cost of all operations for the year, have been forwarded by Mr. Kloeckner; they will show the expense incurred in each department. I also send the underground plans, as prepared by Mr. L. G. Emerson, C. E., showing the openings and stopes for the year.

It gives me pleasure to commend the hearty co-operation which has been shown by my associates, and to note the harmony of action in all departments of work.

F. G. WHITE, *Agent.*

## THE PEWABIC MINE.

The history of the Pewabic Mine, together with a longitudinal section, is given in the Commissioner's Report for 1880, and there is little to add beyond an account of the operations for the past year.

Since the purchase of the Edwards property, in Oct., 1879, the mine has been pushed into this new ground. It will be remembered that the old mine was, in horizontal projection, nearly a triangle, lying between the Quincy and the Franklin, to the apex of which the underground openings converged. Opposite this is the new purchase, the southwest quarter of section twenty-three, into which the openings have since been extended.

The purchase was made for \$275,000. The company made an assessment of \$10 per share, on 40,000 shares, which, with \$2 per share previously assessed and cash on hand, gave a total sum of \$481,000, only \$206,000 in excess of the amount paid for the land. Since that time no additional assessments have been made; the copper produced has had to furnish all the necessary funds for opening the mine and for making very many necessary repairs and improvements. Under such circumstances the work has been greatly restricted, and the management has necessarily labored under disadvantages. The mine has succeeded in keeping even, but no dividend has been made.

The company is fortunate in having the services of one of the best mining men in the country for its agent. Captain Vivian, as agent of the Pewabic, Franklin, and Huron, has his hands full, but he is one of the rare men who combine a thorough, practical familiarity with mining, with executive ability and a knowledge of business, that admirably fit him for his responsible position.

The following is a comparison of the product for the past two years:

	Tons of Rock.	Yield per cent.	Mineral, lbs.	Per Cent.	Ingot, lbs.
1880.....	33,982	2.02	1,172,855	84.48	967,384
1881.....	60,427	1.92	2,247,657	83.32	1,872,878

Average price obtained for copper in 1880, 19 121-1000 cents per lb. Average price sold for in 1881, 17 635-1000 cents per lb; being a diminution in price received per lb., of nearly 1½ cents, thus reducing the net profits of the company \$28,000 below what they would be if the price received had been the same as the previous year.

A surplus of from \$12,000 to \$15,000 or more could be made by taking valuation of rock broken in mine and not hoisted, also by figuring the exact amount received for sales of copper, some of which has been sold at a higher price than estimated.

Annexed are the financial statements of the company, covering the receipts and expenses and the assets and liabilities:

## ANNUAL STATEMENT OF THE PEWABIC MINING COMPANY.

Cash on hand Jan. 1, 1881.....	\$7,357 71
“ received for 1,725,499 lbs. ingot at 17 635-1000 cents.....	304,294 22
“ “ “ 6,243 lbs. mineral at 18¼ cents.....	1,142 34
“ “ “ loans.....	117,920 38

Cash received for interest.....	\$338 92
“ “ “ stamping.....	612 12
“ “ “ supplies sold.....	153 04
“ “ “ sale of drill.....	6,562 93

\$438,381 66

CONTRA, CR.

Cash paid loans.....	\$105,345 38
“ “ mine drafts.....	260,449 61
“ “ smelting.....	20,451 00
Taxes, forfeited stock, brokerage, storage, interest, insurance, freight, etc	25,577 70
Cash on hand Jan. 1, 1882.....	26,557 97

\$438,381 66

The following are the assets and liabilities, January 1, 1882:

Cash on hand.....	\$26,557 97
418,399 lbs. ingot copper on hand, at 19 cents.....	79,495 81
Supplies at mine—cash value.....	63,910 00

\$169,963 78

CONTRA, LIABILITIES.

Drafts outstanding.....	\$24,751 35
Bills payable, and loans.....	98,975 00
Due for forfeited stock.....	1,185 60
Liabilities at mine.....	36,762 00
Due for smelting and freight, estimated to balance.....	8,289 74

\$169,963 78

The number of tons of rock hoisted from the mines in 1881, was.....	68,033
The number of tons of rock rejected was.....	9,687
The number of tons of rock stamped was.....	58,346
The yield of mineral per fathom of rock hoisted was (pounds).....	561½
The yield of ingot per fathom of rock hoisted was (pounds).....	468
The yield of mineral per ton of rock hoisted was (pounds).....	33.04
The yield of ingot per ton of rock hoisted was (pounds).....	27.53
The yield of mineral per ton of rock stamped was (pounds).....	38.50
The total amount of mineral produced was (pounds).....	2,247,657
The total amount of ingot produced was (pounds).....	1,872,878
The per cent of ingot copper to mineral was.....	83 21-100
The total number of feet of shafts sunk during the year was.....	160.4
The total number of feet of winzes sunk during the year was.....	257.3
The total number of feet of drifts extended during the year was.....	1,247.4
The total number of fathoms stoped by hand during the year was.....	658 173-1000
The total number of fathoms stoped with air drills during the year was.....	3,348 117-1000
The total cost of manipulating 1 ton of rock was.....	\$3 49
The average number of men employed was.....	285
Cost per foot for sinking shafts.....	\$20 86
Cost per foot for sinking winzes.....	14 90
Cost per foot for drifting.....	12 86
Cost per fathom for hand stoping.....	22 53
Cost per fathom for air drill stoping.....	14 08

No. 6 shaft—the one through which all the hoisting is done—is down to the 270th level, and will soon be to the 280th; its depth on the lay of the lode, 54°, is 1,920 feet. The 270th level, from the Franklin to the Quincy boundaries, is 840 feet in length.

The great depth to which the mine has attained renders a man engine very desirable; accordingly some progress has been made toward the construction of a man engine shaft. At present the workmen must go down in the mine and ascend on ladders, a heavy task for so long a distance.

The capital stock is \$1,000,000, divided into 40,000 shares. The office is No. 19 Congress street, Boston. D. L. Demmon, Secretary and Treasurer. Johnson Vivian, Agent, Hancock, Mich.

#### AGENT'S REPORT.

D. L. DEMMON, Esq., *Treasurer Pewabic Mining Company.*

DEAR SIR—As with this season of the year it becomes my duty to report of our doings for the twelve months ending December 31st, 1881, I beg leave to submit the following for your consideration.

#### SURFACE.

In this department the following improvements have been made: A drum house, with two drums for operating the incline road to stamp mill; locomotive house, carpenter's shop, with lumber yard enclosed with board fence; blacksmith's shop, which is located adjacent to No. 6 shaft for sharpening miners' tools, etc. An old tenement house has been remodeled and made into an office and warehouse. A dam, which will hold about 100,000 cubic feet of water, which is used for feeding boilers, etc., has been constructed, which will give us a full supply of feed water without melting snow for that purpose, as we were compelled to do last winter.

#### MACHINERY.

We have put up the other half of the air compressor, and added five drills and a pony engine to the underground outfit of labor-saving machinery; all of which, with our surface machinery, is in good repair except three boilers at the hoisting engine, which will require some considerable overhauling ere long.

We have now thirteen drills at work, and two or three more will be added about the first of March, which will be all that is necessary until more hoisting power is provided.

Some considerable work has been done on the man-engine, which we expect to have in operation to the 160 fathom level by the first of June next.

#### STAMP MILL.

Repairs, both ordinary and extraordinary, have been and are still being carried on in this department, which have put three heads of stamps, with all the washing machinery and boilers in good running condition, except one mortar, which was put up as an improvement on Ball's mortar, but, instead of that, it falls vastly short of being equal to what was put up by Mr. Ball. The capacity of the mill is now about 300 tons of rock per day.

#### MINING WORK.

No. 6 shaft has been sunk from the 25th to the 27th level. The lode in this opening is not so productive as we had reason to expect it would be. It seems to be in one of the lean places that are often found in this deposit. In winze sinking below the 26th level, north of the shaft about 60 feet, the lode is showing some good stamp and a little barrel copper.

The 27th level has been opened 15 feet each side of the shaft; the lode at this point has a much better appearance and is more productive than what the shaft passed through. It looks as if some very valuable ground would soon be met with at this level.

The 26th level has been opened north of the shaft to the boundary line



with Franklin. With the exception of about 25 feet near the shaft, this opening has exposed a good paying lode. This level is opened south of the shaft 96 feet. The lode in the drift is very lean, but as there is some good ground going down in the bottom of the 25th level for a long distance, we shall doubtless find that considerable of this back of ground will pay to take out.

The 25th level has been extended north to the Franklin line and south of shaft 240 feet. The lode on the north side is large, and near the line very rich in all grades of mineral. The greatest portion of this block of ground has been removed by stopes. The bottom of this level for about 130 feet in length is well filled with mass, barrel and rich stamp copper, which cannot be taken out to advantage until reached with the stopes from the level below.

On the south side of the shaft some very fair ground was found, and the stopes in this back are still showing a good stamp lode. The last 50 feet opened in this direction are poor.

The 24th level has been extended south 210 feet, all of which, except the last 60 feet, will pay to stope. Considerable more copper has been taken from this point, and the stopes are still showing more barrel and stamp copper in paying quantities.

The 23d level has been extended south 165 feet, at which point it has reached the line with Quincy. The lode exposed in this level contained a very fair amount of stamp and barrel work, and the stopes in this back have paid very well. There is only a small piece of ground left in this block, which is near the line.

The 22nd level has also been opened to the line with Quincy. The lode was found to carry a large amount of good stamp and barrel copper. The 20th level has reached the line, and a winze sunk to the level below. In both of these openings the lode is showing good paying rock. We are now getting a large amount of good stamp work from this point.

We have hired the diamond drill from the Huron Copper Mining Company and started to drill in the foot wall side of the lode, at the 260-fathom level, but up to this date have not found anything of value. We shall also drill in the hanging wall to see if there is anything of value in that direction or not. In the Quincy they have found some rich ground both sides of the main lode.

#### FUTURE PROSPECTS.

If the 27th level proves to be as productive as it now indicates, the prospects for 1882 are very fair. It seems as if we could reasonably expect at least 1,200 tons of mineral; and should we find another old-fashioned bunch of copper, like what has been often found here (and I think our chances for doing so are very good), the product for the ensuing year would be very materially augmented.

For further information in relation to our business I beg leave to refer you to the section and plan of the mine, herewith forwarded, and which has been very carefully marked up to this date; and also to the clerk's report, which gives in detail the cost of each department.

Capt. Josiah Hall, my assistant in the mining department, has, as usual, taken a deep interest in our operations, and has labored hard to promote the best interests of the company. Respectfully,

J. VIVIAN, *Superintendent.*

## THE FRANKLIN MINE.

This mine is looking unusually well and promises to resume the production and paying condition which it held for many years during its earlier history. The company resumed working the mine in 1875 on the expiration of a five years lease, and started with an empty treasury and things badly out of repair. All the expenditures that have since been incurred have been met by the product of the mine, so that no assessment has been made.

Up to December 31st, 1881, there had been made during the year:

349 feet of shaft sunk at an average price per foot.....	\$19 41
281 2-5 feet of winze sunk at an average price per foot.....	11 36
2,535 feet of drifts made at an average price per foot.....	10 57
1,086 fathoms of ground stoped by hand at an average price per fathom.....	16 70
5,664½ fathoms of ground stoped with air drills, at an average price per foot.....	12 40
No. of tons of rock hoisted.....	146,260
No. of tons rejected.....	32,932
No. of tons stamped.....	113,328
The average yield per fathom of ground stoped, of mineral.....	375 lbs.
Average yield of copper per fathom of rock.....	311 "
Average yield of mineral per ton of rock hoisted.....	22.07 "
Average yield of copper per ton of rock hoisted.....	18.31 "
Average yield of mineral per ton of rock stamped.....	28.48 "
The total amount of mineral produced was.....	3,228,270 "
Total amount of copper produced.....	2,678,797 "
The per cent of copper in the mineral was.....	82.97
The average number of men employed was.....	435
The total cost of manipulating the rock per ton was, for the year....	\$2 82

The Quincy, Pewabic, and Franklin are contiguous mines, working the same lodes, but it will be seen from a comparison of the figures that the former is now working in a far richer portion of the deposit than either of the others.

In the Quincy the yield of copper per fathom, in 1881.....	767 lbs.
In the Pewabic the yield of copper per fathom, in 1881.....	468 "
In the Franklin the yield of copper per fathom, in 1881.....	311 "

But the Quincy was never so rich as it is now.

Per cent of copper from rock stamped in 1881.

Quincy.....	3 13-100
Pewabic.....	1 375-1000
Franklin.....	1 181-1000

## AGENT'S REPORT OF FRANKLIN MINING COMPANY FOR THE YEAR 1881.

OFFICE OF THE FRANKLIN MINE, }  
January 16, 1882. }

D. L. DEMMON, *Treasurer.*

DEAR SIR—I beg leave to submit the following report of the operations at this mine for the year ending December 31, 1881:

## SURFACE.

The only extra work in this department is a very thorough overhauling of a number of the old tenement houses which were in a bad condition. The repairs done to them have made them almost equal to new.

## MACHINERY.

There has been added to this department the other half of the air compressor referred to in my last annual report, eight Rand drills and a pony engine. We have now 23 drills and 2 pony engines that are operated in the mine by compressed air. All of which, with our other machinery, are in good repair and working satisfactorily.

## STAMP MILL.

The mill was never in better condition than it is to-day, except one boiler, which requires a new set of flues, which will be put in in a few days.

## MINING WORK.

No. 2 shaft has been sunk from the 20th to the 22d level. The first 60 feet of sinking was done in a small and very poor piece of lode; the balance to the present bottom passed through ground that will pay well to remove by stopes.

We have opened at this shaft by drifts at the different levels from the 16th to the 21st, both inclusive, 1,234 feet, the greatest portion of which was not found to be so productive as in former years, but the 21st level that has been opened, north of the shaft 100 feet, and south 125 feet, has yielded, and is still producing a very fair amount of good stamp and barrel copper. The 22d level will be pushed along as fast as possible, and will doubtless yield more copper to the fathom than anything we have had in this part of the mine for the past two years.

No. 3 shaft has been sunk from the 19th to the 20th level. The lode for the entire distance contained a fair quantity of good stamp and barrel mineral. The openings made in the vicinity of this shaft at the 17th, 18th, 19th, and 20th levels is 656 feet, which in point of value compares favorably with what has been found in this part of the mine for some years past.

The 20th level, which is only opened a few feet each side of the shaft, is showing a good, fair sized lode, with considerable fair stamp rock and a little barrel copper.

No. 5 shaft has been sunk from the 17th to the 18th level. The lode at this point is of more than the average productiveness of the mine. The 18th level has been opened south and connected with the drift at this level from No. 3 shaft, and north of shaft 80 feet, all of which is in good paying ground. There has been opened by drifts from this shaft 644 feet; the greatest part of the lode exposed in these openings will pay to take out.

The section of the mine, plans of which have been sent you, will show at a glance the extent of the openings made and the ground broken in far better language than I could possibly tell you in this report, and to which for further information on mining work I would beg leave to refer you.

## FUTURE PROSPECTS.

Prospects for the ensuing year are at least equal to those of the past. And if the ground about No. 2 shaft proves to be as productive as it now indicates, and all other parts of the mine continue to yield as they are now doing, the product for 1882 will be considerably more than in 1881.

J. VIVIAN, *Agent*.

## THE HANCOCK MINE.

This mine is situated almost within the village of the same name, and its gravity incline railroad, as are those of the Quincy, Pewabic, and Franklin,

is plainly to be seen from the streets of Hancock and Houghton, and the constant rattling of the cars over these tracks gives evidence of the incessant activity which prevails.

The new company to operate the Hancock Mine was organized in the winter of 1879-80, with a capital stock of \$1,000,000, divided into 40,000 shares of \$25 each, and work was immediately begun, and has since been pushed forward with considerable vigor. During the past year 3 additional "lifts" have been sunk, so that the mine is now down to the 9th level, and will soon be to the 10th. The new levels are 100 feet apart. The depth of the mine is 840 feet.

Heretofore the product has all gone out of the adit, which is in the 3d level, but No. 1 shaft has been fitted up with skip road, etc., and is now used for the hoisting, and the adit is used for drainage only.

The lode is a wide amygdaloid belt, somewhat like the Atlantic, but not so uniform. About 2 tons per month of the product is in small masses—barrel work. One mass was found last summer, however, that weighed 5 tons.

The rock yields only about one per cent. of copper; possibly, if it were selected a larger percentage could be obtained, but it is nearly all sent to the stamp mill. So much of the work has been devoted to making the openings that there has not been sufficient stoping done to keep the mill running, and the rock from the drifts and shafts, etc., has been used; only one stamp head has been used, and that has not run full time. It is difficult in a small mine with limited openings and working with hand drills, to keep a Ball stamp at work.

The Hancock Mine needs a compressor and air drills, so that the openings may be more rapidly pushed, and a greater amount of rock obtained from the mine. A fissure vein crosses the south end of the mine, which carries copper in small pieces; small masses of conglomerate occasionally are found. The best portion of the lode is near the hanging; it is bunchy and very wide in places—from 12 to 30 feet, and as in the Atlantic, the hanging is poor, requiring frequent pillars and much timbering. The lode being wider along the hanging wall, is taken down, and the trap falls out a good deal. The company employs about 125 men.

The average cost for sinking shafts was \$25 per foot.

The average cost for drifting varies with the character of the ground, being \$6, \$7, \$10.

Size of drifts 5 feet by 6 feet.

Stoping costs \$9, \$10, \$14, \$16, \$18, \$20 per cubic fathom.

The following is a statement of receipts and expenditures of the Hancock Mining Company from March 1st, 1881, to March 1st, 1882:

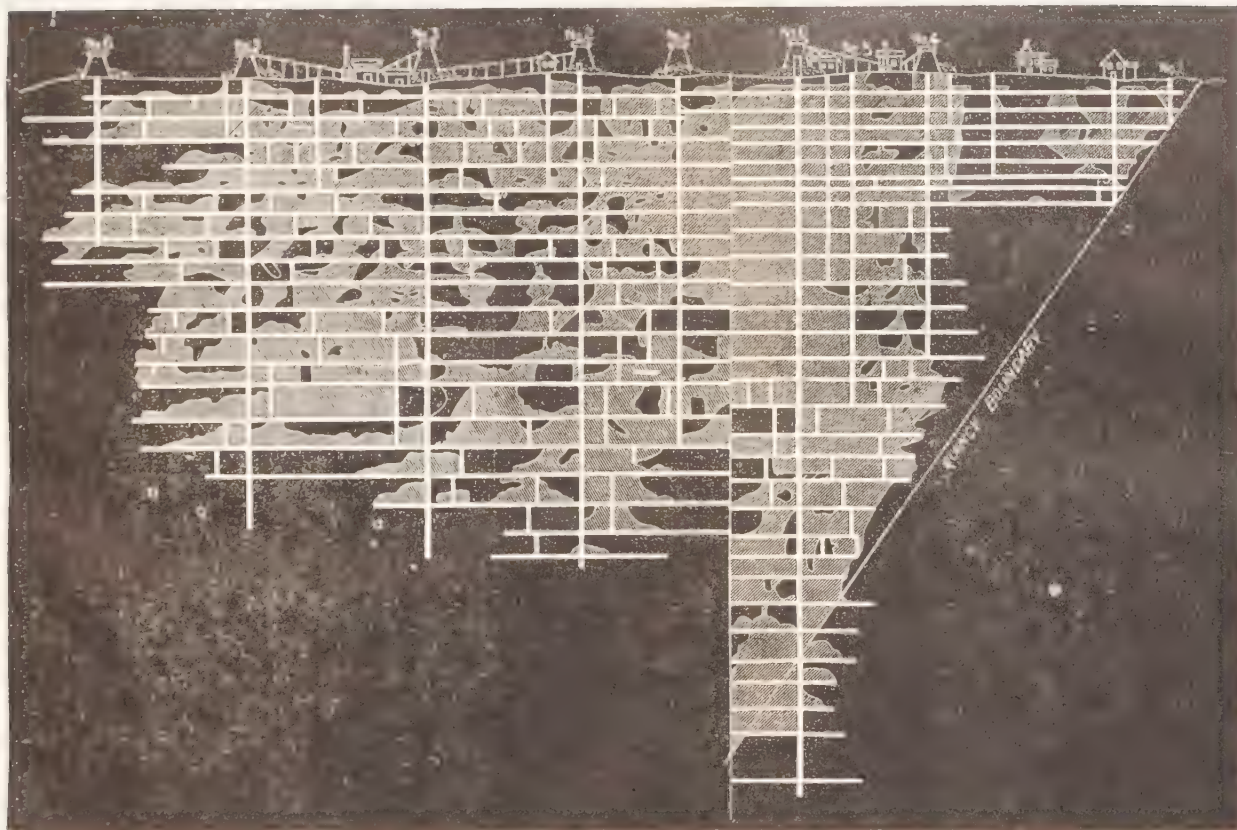
#### RECEIPTS.

For assessment, No. 1.....	\$40,000 00	
For assessment, No. 2.....	60,000 00	
	<hr/>	\$100,000 00
For discount amount borrowed.....	10,000 00	
For amount realized on copper.....	125,024 65	
For amount realized on discounting bills.....	17 71	
For amount realized on pasture.....	191 93	
For amount realized on sale of lot.....	200 00	
For amount realized on rents.....	1,253 84	
For amount realized advanced on copper.....	10,000 00	
	<hr/>	\$246,688 13
		<u>\$246,688 13</u>



LONGITUDINAL SECTION OF THE FRANKLIN AND PEWABIC MINES, JAN. 1, 1881.

Scale, 420 ft. to one inch.





1882, March 1.

To cash balance on hand as above.....	\$1,548 99	
To copper on hand at Chicago and in transit, 50,000 lbs., at 19c.....	9,500 00	
To supplies at mine and mill, including wood, coal, timber, iron, oil, fuse, powder, etc.....	28,263 45	
		<u>\$39,312 44</u>
		<u><u>\$39,312 44</u></u>

EXPENDITURES.

For freight.....	\$3,543 09	
For insurance.....	1,358 50	
For taxes.....	873 05	
For interest.....	901 57	
For smelting charges.....	8,661 30	
For machinery.....	15,250 50	
For construction.....	88,613 13	
For timber, coal, and fire-wood.....	31,296 82	
For freight, insurance and commission on copper sold at Chicago.....	6,095 45	
For expenses at mine.....	75,708 73	
For expenses at mill.....	12,837 00	
		<u>\$245,139 14</u>
Balance on hand.....	1,548 99	
		<u><u>\$246,688 13</u></u>

1882, March 1.

By liabilities as follows:

Amount borrowed.....	\$10,000 00	
Amount advanced on copper.....	10,000 00	
Other accounts unpaid.....	5,414 60	
		<u>\$25,414 60</u>
Net amount of assets over liabilities.....	13,897 84	
		<u><u>\$39,312 44</u></u>

The ground opened during the last year did not turn out as rich as was confidently expected.

During the year they have sunk the main shaft 300 feet, and indications in the bottom of this shaft now are better than at any point yet encountered. The total product since commencement of operations was 965,635 pounds of mineral, or 667,307 pounds ingot copper, which was sold at an average price of 18 7-100 per pound, making the gross receipts from the sale of copper \$125,024.65. In addition to sinking the main shaft as above stated, they have made other necessary openings, such as the sinking of winzes and driving of drifts, so as to be prepared for more extensive mining and larger products.

Owing to the tendency of the ground to disintegrate upon exposure, a great deal of timber has to be used in protecting the openings.

This, together with all the wood required for fuel, must be secured a year in advance, as it cannot be procured in the summer months.

It will be seen by the report that there is a large amount of this, together with other supplies, on hand, which necessarily called for a large expenditure which had to be met.

We were in hopes to be able to show better results, but in opening the mine we encountered a poor section of ground between the 70 and 80 fathoms level. This had to be gone through at as great an expense as though it was rich in mineral, and makes a marked difference in our output of copper. We are now through that, however, and have again reached better ground, and hope to be able to increase our product without any additional monthly expense.

Though we have very good reason to hope, it is of course impossible to look through the ground, hence cannot tell what is in store for us; that, time and labor alone can determine. The mine is well equipped with all necessary machinery, and expenses for improvements in this direction will be light. Every precaution is taken to prosecute the work as cheaply and economically as possible; still, what is done is done well, and with a view to permanency and legitimate mining.

We are working at present about 130 men. I don't think we will have to increase this force for some time. I have the greatest confidence that the mine will be a success, and prove a source of profit to its owners. Certainly, all that can be done in that direction is being done by myself and able assistants, who so heartily co-operate with me.

Yours respectfully,

EDWARD RYAN,  
*President.*

The stock is held in Hancock, Chicago, Milwaukee, Cleveland, and St. Louis. The officers are: Ed. Ryan, President, Hancock, Mich.; August Mette, Secretary and Treasurer, office Hancock, Mich.

#### THE ALBANY AND BOSTON MINE.

This is one of the mines of which large anticipations were held. The company called in assessments to the amount of \$840,000, which, in addition to the money derived from the sales of copper produced, was all expended, very largely in surface improvements.

For upwards of twelve years the mine has been idle, until last summer—1881—parties having secured an option for the purchase of the entire estate, began the work of re-opening the mine, and have since regularly prosecuted mining work.

The estate comprises Sec. 8, except the S. W.  $\frac{1}{4}$  of the S. W.  $\frac{1}{4}$  and the N.  $\frac{1}{2}$  of Sec. 7, and N.  $\frac{1}{2}$  S. E.  $\frac{1}{4}$  and N. E.  $\frac{1}{4}$  of S. W.  $\frac{1}{4}$  of Sec. 7, and the N. W.  $\frac{1}{4}$  Sec. 9, and N.  $\frac{1}{2}$  of Sec. 11, and E.  $\frac{1}{2}$  N. E.  $\frac{1}{4}$  Sec. 10, T. 55, R. 33,—in all 1,720 acres.

The mine openings are in the W.  $\frac{1}{2}$  of the N. W.  $\frac{1}{4}$  of Sec. 8, and commence a few hundred feet east and north from the west quarter post. There are four known lodes crossing the property. The most westerly one being the Pewabic, passes near the quarter-post between Secs. 7 and 9, and running N. 40° E. The east belt is the conglomerate, and crosses about 300 feet north of the section corner—Secs. 7 and 8.

Two hundred feet to the west is the epidote lode, the one opened on the Mesnard. Midway between the Conglomerate and the Pewabic is the Albany and Boston amygdaloid lode, on which the first mining began on this location; but the work was afterwards transferred to the conglomerate, in which they are now working.

The mine on the conglomerate was opened with four shafts, two of which extended down to the 1st level, and No. 1 and No. 2 to the 3d level. The 1st level was drifted 1,800 feet; the 2d level about 1,000 feet, and the 3d level about 600 feet. The dip is 52° to the northwest, and the length of the lode on the property is 5,100 feet. It is a wide belt, corresponding exactly in character to the Allouez—hard and compact, with many large boulders of feldspathic rock, and occasionally copper boulders, which are very rich.

The belt is underlaid with sandstone about 6 feet in thickness, which latter



rests on a bed of amygdaloid trap. The shafts and levels were made in the sandstone.

Years ago, some of the rock taken to the Huron stamp mill was found to yield 4 % of copper, and this result was the basis of high expectations, which were doomed to disappointment when a more general average was obtained. The yield fell to 1.30 per cent.

The parties now operating the mine are Messrs. C. M. Wheeler, of Marquette; J. H. King, James Dolby, of Cleveland; and W. A. Dunn, of Houghton. Their option is renewed to February, 1883, and is \$5 per share—\$100,000. They claim to have already been offered \$100,000 for their chance, besides payment for all the expenses to which they have been.

They commenced regular mining work in November last, and employ about 30 men. They are sinking No. 1 and No. 2 shafts, and the rock which is hoisted is very good, indeed; certainly a 3 or 4 per cent. rock, and it could be selected to a much higher percentage. But the past history of the mine shows that it is well to be cautious. The old company found rich places and held high hopes therefrom, and the good ground through which they are now pushing may not continue.

The large rock-house at No. 1 shaft is the first one built "on the Lake," and is provided with breakers and other machinery, but far less conveniently arranged than are other and later structures.

The stamp mill was burned some years ago, and the timber is now being got out, etc., for erecting another mill. They have contracted for a Ball head, 16-inch cylinder, guaranteed to stamp 200 tons per day. The washers will be on the Collum plan, only no wood will be used—all iron except the launders. The situation of the mill will be about 1,500 feet southeast from the mine. There will be a limited supply of water, but they expect to use it over, pumping it up into the mill and running it back into the pond.

A Burleigh compressor has just been erected to operate two Rand drills, one in each shaft. They are now sinking to the 4th level. The hoisting engine is 24x48 inches; also runs the pump.

A shaft has been started at about 1,550 feet to the east, to strike the Calumet and Hecla lode. The Mineral Range Railroad runs through the property but a short distance from the mine. The location is about midway between Hancock and Calumet.

The capital stock is \$500,000, divided into 20,000 shares. The present holders of the property have not yet organized a new company, but are operating as an association. Capt. W. A. Dunn is directing the operations.

#### THE OSCEOLA MINE.

This mine has a record for good management, perseverance, and the accomplishment of a large amount of mining work that ranks it second to no mine in the district. It is but four years since work was begun on the amygdaloid belt, and during the first year and a half scarcely anything was done beyond exploration: it was then determined to prosecute mining on this lode vigorously; the preliminary work had proved sufficiently favorable to lead to this decision, so that for two and a half years the work has been pushed, resulting in the opening of a mine to an extreme depth of 850 feet, and to an extreme length of 2,250 feet. There are 4 shafts and 9 levels. No. 1, the most northerly shaft, is down to a depth of 850 feet, and No. 2 is nearly to the 8th level, or 750 feet. No. 3 is down to the 7th level, or 600 feet, and No. 4 is down to the 6th level,

450 feet. All these shafts are connected by drifts in the levels to which they reach except No. 4, which is connected with No. 3 at the 2d and 4th levels.

It is a difficult mine in which to push openings; the lode is so broken up and so full of perplexities—contorted, twisted, bunchy, pockety, rich in places only.

Bars of trap frequently occur; long stretches of utterly barren ground intervene between the productive portions, and it taxes the skill of the miner to avoid the lean and hungry places and to reach enough of the good to keep up the product—to avoid mistakes, which are expensive, so as to secure the maximum of product at the minimum of cost.

The mine shows great original disturbances in the lode, distorted laterally and downward. The shafts preserving their uniform, straight course, are anon in the hanging, and then in the foot wall, and in the lode.

The drifts, following the hanging wall, present all the sinuosities of a stream meandering its tortuous way through the meadow. while upward through the stopes the warped surface has every possible direction—sometimes a vertical wall, when suddenly bending, it becomes a roof, showing in different places every possible angle from 90° to the horizontal, and again in places becoming an arch, bending until it nearly touches the foot wall, and then starting upward it perhaps makes again a similar wave.

In passing along the drifts we observe long stretches of barren ground, left standing, and come suddenly upon open chambers which have been worked out, or upon a body of rich ground which is yet to be stoped; possibly one upon which the stopers are at work.

Sometimes through the barren blocks long sinuous “pipes” have been opened, having been made by following up and extracting the included productive rock. But with all the perplexities the work goes steadily forward. The men are distributed through the mine so that there is no interference or hindrance; each party works to the general result; the openings are made. The ground is stoped down, hoisted, and sent to the stamps, and the result is uniformly the same—the same number of tons in the same period of time.

In going through the Lake Superior mines, one who has an acquaintance with mining work can understand, perhaps, how so much money may be wasted by unfortunate mistakes and injudicious planning in the underground work, but in the Osceola blunders were eliminated in advance; it is not easy to see how the work could be better planned or executed.

Heretofore two mines have been worked, the one first opened in the Calumet and Hecla conglomerate, and the one in the amygdaloid. The former, however, has been yearly becoming circumscribed until now nothing remains but the cleaning up in the upper levels.

Below the 3d level this mine is already filled with water, and by the first of May next those above will be completely scammed and the total abandonment of the mine will follow.

The Conglomerate Mine has enabled the Osceola to keep up its product with the hoisting, and working up a less amount of rock than will hereafter become necessary, owing to the greater richness of the Conglomerate lode, but the results of the past year show that the product will be kept up. Since the copper obtained in 1881 exceeds in amount the yield of the preceding year. It took more rock to produce it, but the cost was greatly reduced. Less copper was obtained per ton of rock, but it was obtained at a less cost.

The figures of mining cost herewith given will be found interesting and

valuable, and are obtained from the books of the company through the liberality and kindness of Capt. Daniels.

A fact of possible importance connected with the interests of the mine is the discovery of an intermediate belt between the conglomerate and the amygdaloid. This fact was ascertained by the Calumet and Hecla Company, in driving a cross-cut, in their mine, to the Osceola amygdaloid. At about 650 feet an amygdaloid belt was reached, which is said to be promising. The Osceola Company have since driven a cross-cut 150 feet to intersect this bed, and purpose to explore it, and if sufficiently favorable, to mine it. This cross-cut is in the 9th level.

The respective depths of the shafts have been heretofore given; the distance which each one has been sunk during the year is as follows:

	Feet.
No. 1 shaft has been sunk in the past year.....	199.1
No. 2 " " " " " " " ".....	242.20
No. 3 " " " " " " " ".....	91.6
No. 4 " " " " " " " ".....	269.8

The shafts in the Operchee, which are to the south, have been sunk within the past year:

	Feet.
No. 1 is below the surface.....	411.9
No. 2 is below the surface.....	249

No. 1 shaft, below the 6th level, continues good, being in the foot wall 130 feet, 20 feet below the 8th level, where a change occurred in the dip; but the lode preserves a good average width, though variable in quality. There seems to be a reasonable certainty of going down in good ground.

The 8th level north of No. 1 is 14 feet wide and of good character, but the same level south does not prove so satisfactory, the lode here being not above 6 feet in width.

The 7th level north of No. 1 shaft has been very good, but has been found to possess less than an average width, being seldom more than 10 feet wide. In the same level south of No. 1 is better ground than any other found in the mine, for the distance thus far opened, some portions being unusually rich and the lode wide.

In stoping upwards the lode rapidly narrows, and becomes lean; it is thus inferred that the larger portion of this rich deposit will be found in the back of the 8th level.

The 6th level, north of No. 1 shaft, has opened up, apparently good, having a good width and carrying a fair percentage of copper. The level south of No. 1 shaft, after passing the first 120 feet, showed poor and narrow; the prospect in this part of the level is the reverse of encouraging.

In the 5th level, north of No. 1 shaft, bars of poor ground were frequently encountered, but a portion of it pays for stoping; the width is sometimes not above 6 feet, and the stopes run poor, as they rise 30 feet or 40 feet above the bottom of the level.

Some exploration was done in extending the 4th level north from No. 1, but it resulted in nothing favorable.

In No. 2 level, north of No. 1, but little work has been done; the ground shows poor, and ventilation is poor.

In No. 1 level, north of No. 1 shaft, work has continued without interruption; the breast now is narrow, but fairly good.

The sinking of No. 2 shaft has at no point shown the hanging wall of the lode or revealed anything of value. Recently in this shaft they cross-cutted



at the 7th level, through the lode to the hanging wall, and found 10 feet of lode between it and the shaft.

The 6th level south of No. 2 shaft proved poor for a distance of 200 feet; it was narrow and hard, but is now improving.

No. 3 shaft has not been pushed for want of pumping facilities.

No. 4 shaft has been generally sunk in the foot wall of the lode.

The best ground is now between No. 2 and No. 3 shafts. The poor ground seems to have a general inclination to the south; it has thus far proved to be very embarrassing. Three small engines are used in the mine for hoisting underground, the motive power being compressed air. The average mining force employed was 156 men, of whom 20 worked on the conglomerate. Twenty-four power drills were worked, one-half of which were used in the openings. In July last an additional compressor was added to the mining plant, a duplex Rand, 16x36 inches, and the rolling stock for transporting the rock to the stamp mill has been increased by the purchase of 1,141 new cars. The new compressor building is of stone, 36x46x16 feet. The pumping machinery from the conglomerate has been transferred to No. 3 shaft, and it will suffice for any depth.

A new rock-breaker 9x15 inches has been added, thus making the number 10 in all now in use. The rock house and machinery from the conglomerate will be transferred to No. 2 amygdaloid shaft. Several new houses have been built on the location; others painted and otherwise repaired.

At the stamp mill, which is at Hancock, a new boiler and condenser have been added, and a new force pump, to furnish the water for washing, is now being supplied.

No hand-drilling is now done; the two compressors supply all the power required for this work. In 1879 drilling was all hand work. In 1880 and 1881 it was done by power drills. The average cost for each of the three years is shown in the following table:

	1879.	1880.	1881.
Shafts cost per foot.....	\$25 38	\$18 67	\$15 22
Winzes cost per foot.....	11 14	12 36	11 39
Drifts cost per foot.....	10 42	10 11	8 66
Stoping cost per fathom.....	15 33	9 72	10 78

#### GENERAL EXPENDITURES FOR 1881.

	Expenditures.	Per cent. of expenditures.
Conglomerate Mine.....	\$31,287 82	073.22
Conglomerate rock-house.....	5,922 16	013.85
Amygdaloid Mine.....	227,681 41	532.90
Amygdaloid rock-house.....	19,767 16	046.26
Transportation.....	50,812 05	118.93
Stamping.....	70,895 24	165.93
Surface.....	7,966 44	018.71
Office.....	6,836 74	016.00
Incidental.....	6,069 23	014.20
Total.....	\$427,238 25	
Construction account.....	46,128 38	
Total expenditures.....	\$473,366 63	



The total number of tons of rock hoisted from the mine 190,060; number of tons stamped was 160,880; number of tons rejected, 29,180, which yielded 4,807,424 pounds of mineral, and smelted, gave 4,179,976 pounds of ingot copper, which sold for an average price of 10.22 cents per pound, making the aggregate receipts from sales of copper, \$427,238.25, delivered at the smelting works.

The yield of mineral per ton of rock was 29.88 pounds; the yield of ingot per ton of rock was 25.98 pounds.

No. of fathoms stoped on the Conglomerate belt, 1,106.03; price paid per fathom, \$12.74.

AMYGDALOID BELT, 1881.

No. feet of shafts.....	815.2
Price per foot.....	\$15 22
No. of feet of winzes.....	815.60
Cost per foot.....	\$11 39
No. of feet of drifts.....	4,671.20
Cost per foot.....	\$8 66
No. fathoms stoping.....	7,240.97
Cost per foot.....	\$10 78
Amount paid for sinking shafts.....	\$12,408 80
Amount paid for sinking winzes.....	9,292 87
Amount paid for drifting levels.....	40,479 72
Amount paid for stoping.....	78,173 12
Total surface expenses.....	7,966 34
Total construction expenses.....	46,128 38
Total number of tons of rock hoisted.....	190,060
Total number of tons of rock stamped.....	160,880
Total number of tons rejected.....	29,180

The cost per ton is itemized as follows:

Per cent. of refined copper to the rock stamped.....	01.29
No. pounds of copper from each ton stamped.....	25.98

	Cost.	Per cent of whole cost.
Mining cost.....	\$1,6096	60.612
<i>Assorting and breaking rock:</i>		
Rock-house expense.....	1596	060.11
Transportation cost.....	3158	118.93
Cost of stamping and washing.....	4407	165.93
Surface expense.....	0497	018.71
Office expense.....	0425	016.00
Incidental expense.....	0377	014.20
Total cost per ton of rock.....	\$2,6556	100

The following table shows the proportional cost of the underground work, calling the total underground mining cost unity:

	Per cent.
Underground contracts.....	57.86
Tramming.....	09.54
Timbering.....	07.48
Company per cent. of change house cost.....	06.89
Supervision.....	01.54

Mechanic labor.....	01.54
Drill sharpening.....	00.17
Hoisting and pumping.....	07.73
Supplies.....	03.31
Compressor cost.....	04.43

Total underground mining expense..... 100

Labor expense was 56 % of total underground cost; supplies cost 44 % of total underground expenses.

The product of the mine was 4,797,396 pounds of mineral, or 2,403 638-2000 tons, which, being smelted, yielded 87 130-1000 per cent., or 4,179,976 pounds of refined copper, for which, at about 17 76-100 cents per pound has been realized

The sum of.....	\$742,585 84
From sales of silver.....	2,694 25
From receipts of interest.....	8,894 96

Making gross receipts.....	\$754,175 05
Expenses at mine were.....	\$439,491 08
Other expenses were.....	88,178 99

Making total cost of copper..... 527,670 07

Leaving as mining profit.....	\$226,504 98
Deduct amount of constructing.....	46,128 38

Leaves as net profit.....	\$180,376 60
And balance of assets January 1, 1881.....	\$391,041 39
Less dividend paid in 1881.....	225,000 00
	166,041 39

Leaves as balance of assets January 1, 1882..... \$346,417 99

From which a dividend of \$50,000 was declared payable January 2, 1882.

No mine on the lake is more completely equipped than the Osceola. In respect to its plant and its arrangement for complete and economical working it is second to no other mine, and has few equals. If the company owned a railroad and could thus do its own transportation, this excessive cost, amounting to 1-8 of all its expenditures, could be reduced. The rock from the mine to the stamp mill on Portage Lake is transported over the Mineral Range Railroad, and cost the past year, as shown in the table previously given, 31.58 cents per ton, or about 3 cents per ton per mile; whereas, at the Atlantic Mine, operating its own railroad, the cost is 1.9 cents per ton per mile. That the mine is well managed no other evidence is needed than the fact that a mine requiring to be so extensively opened as does the Osceola, in order to obtain a rock that yields only  $1\frac{1}{4}$  per cent., is able to pay an annual dividend of \$225,000 to its stockholders.

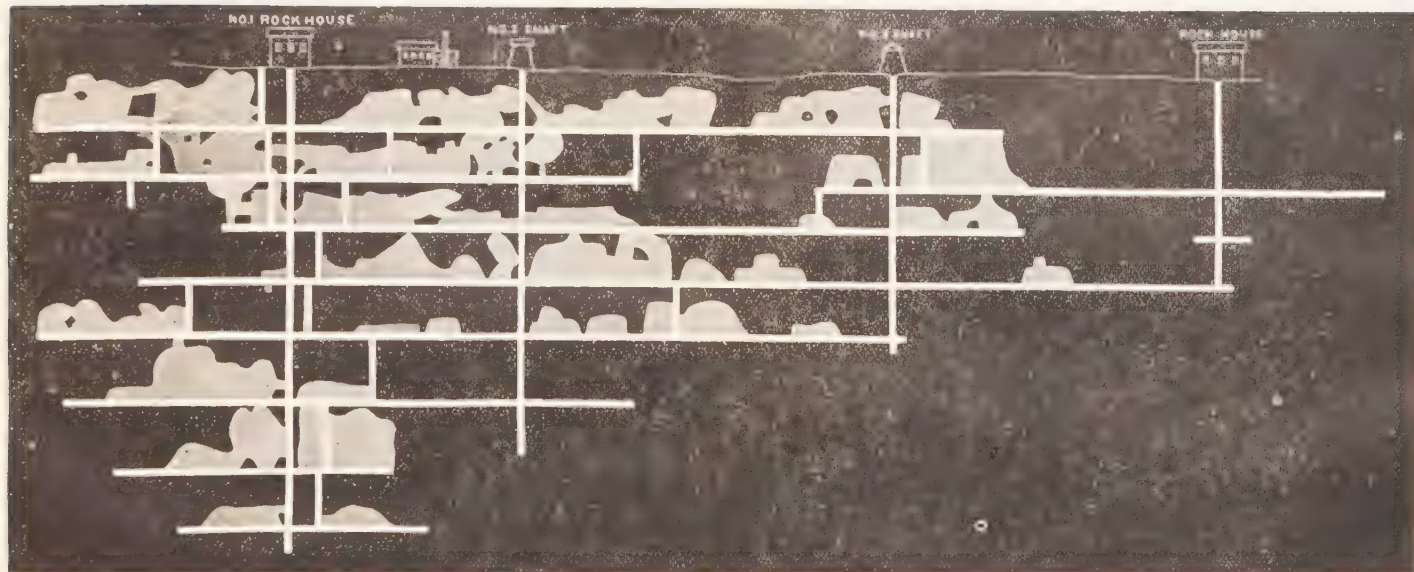
Capt. John Daniels, the agent, is everywhere regarded on Lake Superior as one of the most intelligent and thorough mining men that the country affords.

The capital stock is \$1,250,000, divided into 50,000 shares of \$25 each. The office is No. 178 Devonshire street, Boston. James D. Clark, President; A. S. Bigelow, Secretary and Treasurer. Total dividends paid to date, \$685,000.

The following figures will serve as comparison between the Osceola, the Quincy, and the Atlantic:

LONGITUDINAL SECTION OF THE OSCEOLA MINE (ON THE AMYGDALOID VEIN), 1882.

Scale, 240 ft. to one inch.







	No. tons of rock stamped.	Yield of copper. Pounds.	Yield per ton of rock. Pounds.	Per cent. of copper to rock.
Osceola.....	160,880	4,179,976	25.98	1.29
Quincy.....	98,869	5,702,606	57.70	3.13
Atlantic.....	176,055	2,528,009	14.36	0.718

	Cost per ton to stamp.	Mining cost per ton.	Net profit on business for the year.	Dividend paid, 1881.
Osceola.....	44	\$2 65.56	\$180,376 60	\$225,000
Quincy.....	72.30	2 73	466,438 39	440,000
Atlantic.....	42.54	1 75	82,952 55	80,000

Without power drills and giant powder it would have been impossible for the Osceola to have continued work, much less have made a profit. By employing these great forces they are enabled to push forward their openings 1,000 feet per month, and to do it at one-half the expense it formerly required. A few years ago it cost the Osceola \$25 per foot for sinking and drifting; now it costs but \$12. Formerly it cost \$7 per ton for stoping rock. The directors once passed a resolution requiring Capt. Ryan to bring the cost to \$5 per ton; now it costs but \$2.65 per ton. Hercules powder and air drills have accomplished this; but it is also due in part to the fact that men accomplish more now than formerly. They are required on their contracts to push things; it is known what they can do, and they must do it, or they will fail to get contracts. Formerly when men got a good contract they would take it easy; work but a few hours at a shift, and get about the same done as if they had a poor contract and had to work harder.

#### THE CALUMET AND HECLA MINE.

The heavy machinery which the Calumet and Hecla Company has been adding to its mining plant, or rather which is to substitute that heretofore used in the Calumet Mine, is all in place and nearly ready to work. The monster engine is estimated at 4,700 horse power, and has an ordinary working capacity of 2,700 horse power. It is designed to work the shafts in the Calumet Mine, both man-engines, the two great pumps, and the compressors. The compressor and hoisting machinery for the Calumet Mine are in the same building with the large engine, constructed for the purpose. The pumping and man-engine machinery are placed in a separate building, standing south of the first, and the boilers are in a building to the east. All these structures are of stone and brick, etc. The new boilers are each 38 feet long and 8 feet diameter, and are steel. The mine has 11 shafts, 5 in the Hecla and 6 in the Calumet Mine. Six of these are down to the bottom level—the 27th—a length on the lay of the lode of one-half mile. No. 5 shaft, in the Calumet, is only down to the 23d, and has heretofore been used as a ventilating shaft, but as the mine is extending in that direction it will be fitted with a skip-road and be used hereafter, in hoisting. In the lower levels the drifts are extending toward it. No. 3 and No. 4 shafts are down to the 9th and 19th levels respectively, and are connected. The main copper ground inclines downward to the north.

A sufficiently full description of the mine is given in the Commissioner's Report of 1880, and there is little more to add. The additional statistical information obtained is so meagre as to be of but little value. The dip and trend of the lode are remarkably uniform, so that the drifts in the lode are very regular; the lode is all stamp rock, and the amount hoisted and treated is about 1,200 tons per day, having been somewhat increased through the introduction of steel skips and the enlargement of the pulleys from 6 feet diameter to 9 feet.

The hanging wall is very insecure, requiring for its support an excessive amount of timbering. Getting these timbers down into the mine consumes much of the working time of the shafts, and in a measure limits the amount of rock hoisted.

The estate comprises 1,720 acres in Secs. 13, 14, and 23, T. 56, R. 33, being all of Sec. 23 and all of Sec. 14, except the W.  $\frac{1}{2}$  of the S. W.  $\frac{1}{4}$ , owned by the Tamarack, and on which that company has begun to sink its vertical shaft. In Sec. 13 the Calumet and Hecla owns 520 acres, the remaining 120 acres belonging to Messrs. Loring, Palmer, and the heirs of Wm. B. Frue.

It is stated that the Calumet and Hecla has recently contracted for the purchase of this land, agreeing to pay therefor the sum of \$1,250,000, or nearly \$10,417 per acre. The land is said to have cost these parties, some years ago, the sum of \$20,000. Since that purchase, however, the workings of the Calumet and Hecla mine have sufficiently demonstrated the fact that the lode continues in all its richness beneath this land. That such an apparently enormous price should be asked and paid for a limited piece of wild land that has no possible value beyond that derived from the supposed existence of a deposit of conglomerate lying 2,000 feet beneath its surface, illustrates the wondrous richness of this great mine.

But a better illustration is the fact that the mine pays a regular quarterly dividend of \$500,000, and occasionally increases it with an extra, and has paid in all, within the past 14 years, the total net sum of 21,350,000.

Everything about the Calumet and Hecla is done on a scale commensurate with the greatness of the mine, and as the mine has an assured future of continued richness, the buildings and machinery, etc., are intended to endure for a long time to come. The expense does not seem to be much of a consideration; durability and magnitude are the chief requisites. A large machine shop, fully supplied with machinery for making all kinds of repairs is provided, an immense shop for sharpening drills, etc., paint shop, etc., and a new stone building for the machinery used in the manufacture of the electric light employed in the mines.

It is claimed that the machinery at the Calumet and Hecla excels that found at any other mine in the world, particularly the Hecla and the Calumet engines. The former is a compound Leavitt engine, 1,000 horse power, which does the hoisting in the Hecla Mine, and also runs the double compressor. The power is applied by means of wire rope transmission, running over immense, winding drums, of which there are four, in the same building with the engine; they are each 25 feet in diameter and 7 feet face.

The cylinders, high pressure, are 23 $\frac{1}{2}$  inches in diameter, and the low pressure 36 inches, with 6 feet stroke. The 3 boilers that furnish the steam are of steel, each 38 feet long, 8 feet diameter. This machinery, so intricate, so powerful, working so silently, has a marvelous beauty, and is well worth a journey to see. At present there are in use on the location, all told, 16

engines, and the object of the powerful engine now being put in, is to displace some of those smaller engines, and let one do the work of many. The weight of the big engine is given at 700,000 pounds. The cylinders are respectively 5 feet 10 inches and 3 feet 6 inches diameter. The engine is said to be the largest stationary engine in the world, and cost \$100,000.

In the stone building south of the new Calumet engine house, the cost of the machinery is given at \$500,000. It is not easy to see the necessity of such ponderous pumping machinery in a mine that makes so little water as does the Calumet and Hecla.

About the mine have grown up the villages of Calumet and Red Jacket, which have a population of about 6,000 persons, all of whom are directly or indirectly supported by the mine.

The lode extends on the Company's property, across two sections, 23 and 14, on a bearing of N. 39° E., and dipping 38° northwesterly. The mine commences at the south line of the property, and extends north 5,700 feet; further north the value of the lode is doubtful, since on the Schoolcraft, the next mine joining it on the north, the lode proved nearly worthless; 4,200 feet in length of the ground that is opened, is considered first-class, yielding 20 pounds of copper to the ton of rock. In addition, 800 feet to the east, the company has the Osceola amygdaloid belt, which they have just tapped by a cross-cut, and also intermediate between it and the conglomerate, was crossed a heretofore unknown amygdaloid lode, which seems to be equally promising as the Osceola. This cross-cut, extending from the 9th level, will be continued to the east line of the property in order to prove the ground; the distance will be about 2,100 feet. As in the Atlantic Mine, no rock is rejected except such as falls out from the hanging wall, which latter amounts to about two per cent. of the whole. The lode is all taken down, leaving only an occasional pillar; in width it varies from 8 feet to 16 feet, and in texture is compact and hard. It is like a quarry; the slope is a very advantageous as well as a uniform one, and the levels are laid out with the utmost regularity.

The Calumet and Hecla so far overshadows all other mines in the copper district, in its expenditures, in its receipts, in the richness of the mine, in the out-put of copper, and in the greatness of its profits, that there is no comparison to be made between it and the others. A course of operations and expenditures that would speedily swamp any other mine on the lake, can be undertaken by the Calumet and Hecla without the least concern; its profits will be sure to meet all costs, and still leave enough for enormous dividends.

Of the 24,689½ tons of refined copper reported from the Lake Superior mines in 1880, over 15,837½ tons were the product of this one mine; and of the total amount of 301,053½ tons obtained from all the mines since the advent of this industry in that country, up to the same year, 126,558 3-5 tons have been obtained from the Calumet and Hecla in a period of thirteen years.

Of the \$2,805,000 of dividends paid to stockholders by the Lake Superior copper mines in the past year, \$2,000,000 were paid by this company alone; and of the total dividends paid by Lake Superior copper companies to December 31, 1881, amounting to \$32,370,915, more than two-thirds, or \$21,350,000 has been paid by this single company.

The Calumet and Hecla is one of the world's phenomena. There is no other such an uniformly rich deposit anywhere. The other Lake Superior companies, by the best of management and the closest economy, can just



manage to exist. Some of them congratulate themselves on being able to make a small dividend, under favorable circumstances, but this great mine need take no thought of economy; in fact, as compared to its neighbor, the Osceola, it apparently does not. It ships its thousands of tons annual product, and returns as regularly to its stockholders its millions in dividends. Rich in the present and assured of the future, it is no wonder that its shares are a coveted possession.

The capital stock is at the limit allowed by the State law—100,000 shares, par value \$25, though the latest market quotations give the actual value to be \$245 per share, thus making the market value of the mine \$24,500,000.

The officers are Alexander Agassiz, President; Chas. W. Seabury, Secretary and Treasurer; Office 67 Milk street, Boston, Mass. J. N. Wright, Agent; John Duncan, Assistant Agent, Calumet, Mich.

### THE CENTENNIAL.

Lying adjacent to the Calumet mine, on the north, is the Centennial,—formerly the Schoolcraft. It will be remembered as described in a previous report that the earlier company worked very zealously for success in the Calumet and Hecla conglomerate; but the extension of the lode on this property proved so utterly worthless that the company, after a few years' struggle, was entirely ruined. Its experience was a valuable acquisition to the country, but an expensive one for the stockholders.

The property comprises the S. E.  $\frac{1}{4}$  of Sec. 12, T. 56, R. 33.

In 1876 the property was bought at bankrupt sale, and the organization of a new company decided upon, to be called the Centennial. In the latter part 1880, work was begun by the new company on the Osceola amygdaloid. Two shafts were started 660 feet apart, and the work of opening another mine was begun, and has since been pushed along with reasonable activity.

The two shafts have been connected at the first level, and in addition have driven south from No. 2, 120 feet, making about 780 feet of drifting done in the first level.

No. 2 shaft is down to the 2d level, and they have drifted from it north and south, each way, just far enough to sink to the 3d level. North from No. 2, a winze is sinking to the 2d level, and also south from the same shaft in this level, a winze is sinking to the 2d. Four or five air drills are at work, and they are able to make about 80 feet per month. A Burleigh compressor, one that was on the ground, is employed, but it is the intention to replace it with a Rand duplex.

There are two hoisting engines which operate the shafts, and one of them, in addition, works also the pump, and the other the compressor, the power being applied by wire rope transmission.

In drifting they follow the hanging wall. The lode is bunchy—in one place where they have drifted across it, it shows a width of 24 feet. No stoping has as yet been done, the work being devoted to opening the mine and repairing the buildings, etc. The stamp mill is being put in order. It stands near the highway which runs north through the property, and was supplied with water through a launder from a dam across Calumet Creek. The capital stock is \$1,000,000, divided into 40,000 shares, 20,000 of which were sold to provide the working capital.

It is the intention of the company to cross-cut to the new amygdaloid bed,



cut by the Calumet and Hecla Company, which should lie about 250 feet to the east. The expenditures thus far have been \$55,000.

The officers are: S. L. Smith, President; A. W. Jackson, Secretary and Treasurer, New York. Wm. Harris, Acting Agent, Houghton. Joshua Hostin, Mining Captain.

#### THE TAMARACK MINING COMPANY.

One of the most interesting projects lately undertaken on Lake Superior is that begun by the Tamarack Mining Company, which company was organized in January, 1882, with a capital stock of \$1,000,000, divided into 40,000 shares. The company is an offshoot of the Mineral Land Company, and the latter has set off to the Tamarack 1,280 acres of land, in Secs. 10, 11, 14, 15, being the N.  $\frac{1}{2}$  and the N.  $\frac{1}{2}$  S. W.  $\frac{1}{4}$ , and N. E.  $\frac{1}{4}$  S. E.  $\frac{1}{4}$  of Sec. 15, and the S. W.  $\frac{1}{4}$  and W.  $\frac{1}{2}$  S. E.  $\frac{1}{4}$ , and S. E.  $\frac{1}{4}$  of S. E.  $\frac{1}{4}$ , and N. E.  $\frac{1}{4}$  of N. E.  $\frac{1}{4}$  of Sec. 10, and W.  $\frac{1}{2}$  of E.  $\frac{1}{2}$  S. E.  $\frac{1}{4}$  and S. E.  $\frac{1}{4}$  N. E.  $\frac{1}{4}$  Sec. 11, and W.  $\frac{1}{2}$  S. W.  $\frac{1}{4}$  Sec. 14, T. 56, R. 33.

The company has begun the work of sinking a vertical shaft, near the southeast corner of the property; that is, near the S. E. cor. of the W.  $\frac{1}{2}$  S. W.  $\frac{1}{4}$  of Sec. 14, giving a length of lode between the south and east boundaries of the 80, where it will be intersected by the downright shaft of about 500 feet. The work is in charge of Capt. Daniels, of the Osceola. In fact the men who are at the bottom of the enterprise are the same parties who control the Osceola—J. D. Clark, Erastus Corning, etc.—and represent a large capital. The plan of the Tamarack Mining Company is to go down with a vertical shaft. At a depth of about 600 feet this would tap the "Allouez conglomerate," and easy cross-cuts would prove that lode several hundred feet deeper than it has yet been seen, and admit of the rapid opening of an extensive mine. This alone, as a mining venture, would deserve careful consideration.

Underlying the Allouez lode, and between it and the Calumet conglomerate, which will be reached at a depth of 2,100 feet, are a series of amygdaloid beds or lodes, which have not been examined in the county of Houghton, except at the surface. Some of these in Keweenaw county are copper-producing.

The fact that a valuable amygdaloid lode was most unexpectedly encountered in the Calumet and Hecla Mining Company's cross-cut, east, at the thirteenth level, lends an importance to this enterprise. After reaching the Calumet conglomerate less than 600 feet of sinking will expose the Osceola amygdaloid. A system of cross-cuts, with modern mining facilities inexpensive and expeditious, would, from the depth last named, make available about 1,800 feet in length of the most productive copper lode in the world.

The Osceola amygdaloid is now proved to be an important and profitable copper producer, and it should be noted that the Calumet and Hecla Mining Company, in cross-cutting to reach this lode, made the discovery before alluded to, thus proving the existence of an important, and at the point of discovery, rich lode, which also dips into this property. Consequently the Tamarack Mining Company will have placed in its hands the opportunity of working three of the best known and defined belts of the country, to say nothing of those on which, comparatively, no examination has before been made.

The Tamarack land on which the lode is sinking "corners in" on the Calumet and Hecla. The shaft is started as far east as practicable, so as to strike

the lode as near the surface as they can reach it. After reaching the lode they can then work down on the incline of the deposit, which, dipping to the northwest, will give constantly additional length as they go down.

The following interesting paper on the undertaking by the Tamarack Company is prepared by Capt. Daniels, for the Report of Commissioner of Mineral Statistics:

"The Tamarack is one of the most interesting, and perhaps important undertakings ever commenced in the copper region of Michigan.

"It is not to be wondered at that the extension of the Calumet conglomerate beyond the limits of that mine should receive attention, for there can be but little question but that this lode will yield more profit in the aggregate than any other vein or lode yet opened in the United States. The Schoolcraft on the north, and Osceola on the south of the Calumet and Hecla, on the same lode, were neither of them permanently successful. The Osceola got a mere taste of the conglomerate productiveness, and the Schoolcraft less than that. The Tamarack, however, takes the dip of the lode from the Calumet and Hecla Mines, and if the copper-courses are continuous, must encounter them. The extent of the territory is ample, and is so situated that it surrounds the main part of the Calumet and Hecla Mines.

"In working the Calumet and Hecla the position of the Frue 80 acres interferes with the sinking of the Hecla shafts, Nos. 3 and 4. A continuation of these shafts on the plane of the lode to depths of 3,500 and 3,800 feet, respectively, will strike the Tamarack lines. No. 2, Hecla, will run nearly 4,400 feet deep, and those further north deeper proportionately, but all will, if sunk, run into the Tamarack. Those furthest north will run deep, but it must be remembered that the Calumet and Hecla is the result of about 16 years' work, and that the 28th level has been reached at a depth of over 2,500 feet on the plane of the lode. This, notwithstanding the fact that the region profited very little either by drilling machinery or the use of high explosives, except in the last five years. On the matter of progress in opening mines one should rather look for further improvement than expect any retrogression.

"The owners of the Tamarack recognize these facts, and believing that the lode can be as easily followed, perhaps more easily followed from perpendicular shafts than by the system hitherto in vogue, they have inaugurated what may be termed a new departure in the copper region, namely, to sink a perpendicular shaft about 2,000 feet deep, and strike the Calumet conglomerate on the same horizon as the Calumet and Hecla Mine reaches when it is 3,500 feet deep.

"The regular mode of working the bedded deposits is to uncover the outcrop, and after cribbing up a shaft on same angle of inclination through the overlying sand, sink on, or follow the lode bed, or belt in its dip with the strata, of which it is an integral part. These shafts are found on inclinations varying from 25° to 54° from the horizon, those at and around Calumet dipping at about 37° to 38°.

"It is easy to see that under these circumstances a much shorter outlet to a mine is attainable by sinking a perpendicular shaft than by following the inclination of the bed worked. Whether other considerations can be as easily met will probably be determined here. The local management of the Tamarack do not hesitate to speak in the affirmative.

"Stepping into the coal regions of this and other countries, and noting shafts deeper than this now proposed, with openings from them extending miles underground, and we conclude that there is nothing new in this undertaking

that has not been successfully met before. For deep sinking the copper region affords advantages rarely met elsewhere. But little water permeates through the rock after a depth of 300 feet is reached, and the increase in temperature is not very apparent in the deepest mines.

"The consideration first with the Tamarack Company is that they have no other means of access to the mineral deposits that underlie their property, so that unless this mode of working is carried out, they could only realize from those which outcrop on the Calumet Mine, by selling to that company. Some of the inducements for retaining these lands are worthy of notice.

"The working length of the Calumet and Hecla, old mine, is not much, if anything, short of a mile. The South Mine, near the Osceola, when developed, will probably exceed half a mile in length, with every prospect of the ore bodies uniting before the South Mine is as deep as the principal part of the mine is at this time. The giving out of the copper in depth has not received serious consideration, and as the rock now treated in the stamp mills of the Calumet and Hecla is of better average yield than formerly, it may be assumed that up to this time the reason for doing so has not become apparent. If the copper holds down the Tamarack gets it. It has continued down 2,500 feet, and less than another 1,000 feet will reach the line that separates the two properties. The risk then is reduced to a small one, and the chances, as we shall see, are large.

"It would be difficult, for lack of data, to speak of the business of the Calumet and Hecla in a particular way, and we further feel that it would be out of place here to do so, but sufficient has been made public to throw a good deal of light on the Tamarack's chances, and these we would merely glance at, confining statements to inside figures.

"The Calumet and Hecla Company divides \$2,500,000 among its stockholders, and the very important improvements of late years would absorb a further expenditure of \$500,000; for the machinery erected is of the most costly character, while it seems large enough to reach any required depth. The receipts then, beyond running expenses, would be, say \$3,000,000. The amount of rock treated in the stamp mills does not exceed 1,000 tons per day, say 370,000 tons yearly.  $\$3,000,000 = \$9\frac{1}{4}$  as profit obtained per ton of rock.

"Admit that the price of copper averages high compared with a few years ago, and set the profit at \$8 per ton of rock treated. When it is understood that the Atlantic and the Franklin Mines earn less than \$1 per ton on rock treated, the Osceola less than \$1.50, and the Quincy Mine, in her most prosperous year, less than \$4 per ton, and then on about one-third the quantity of rock, it will be seen that the effort to get a share of those unusual (in copper) profits, is promoted by very strong incentives.

"It would be safe to assume that the rock from the Calumet and Hecla Mines produces from 4 % to 5 % of ingot copper,—say the less named. A cubic fathom of conglomerate would then produce 1,600 pounds of copper, worth at 15 cents per pound, \$240. Assume that the lode or bed is 8 feet thick—it is probably more—it will then afford for each 40 acres, 80,000 fathoms, or 1,600,000 tons of rock, equal to five years output as at present from the Calumet and Hecla Mines, and \$15,000,000 of profit, if it is practicable to extract the copper as economically as they have been doing.

"Without intending any reflection on the Tamarack management we will say that the working of 40 acres of their property should yield a profit of

\$10,000,000, assuming, of course, that the lode bears its regular size and character for productiveness in the tract worked.

“In running over these figures one cannot but be impressed with ideas that there are indications of extravagance about them; but the statements made are borne out by results in the past, and there is no reason at present to look for less favorable returns than have been made. It may be that this will assist in comprehending more fully the capabilities of the Calumet conglomerate, but it is only put forward to show what the possibilities are for the Tamarack.

“The new shaft will encounter many of the lodes of the country, prominent among them the Allouez, which will be cut at a depth of about 500 feet, and many are of opinion that here it will be highly productive.”



## COPPER INDUSTRY STATISTICS.

### TOTAL DIVIDENDS PAID BY LAKE SUPERIOR COPPER COMPANIES IN 1881.

Companies.	Dividend.	Total to date.
Atlantic.....	\$80,000	\$260,000
Cliff.....		2,227,660
Calumet and Hecla.....	2,000,000	21,350,000
Central.....	60,000	1,664,000
Copper Falls.....		100,000
Franklin.....		240,000
Minesota.....		1,920,000
National.....		319,255
Osceola.....	225,000	385,000
Pewabic.....		460,000
Phoenix.....		20,000
Quincy.....	440,000	2,810,000
Ridge.....		100,000
Ogema.....		15,000
Total.....	\$2,805,000	\$32,370,915

### STOCK QUOTATIONS.

The following table shows the stock quotations in Boston, of Lake Superior copper mines for several years past, taken from Martin's Stock Reporter :

# ANNUAL REPORT OF THE LAKE SUPERIOR MINING COMPANIES.

Lake Superior Cop- per-Mining Com- panies.	Dividends. When paid.	1878.		1879.		1880.		No. of shares.	Assessed per share, total.	
		Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.		Jan. 1881.	Jan. 1882.
	1881.									
Allouez.....		50c	4	3	10	2½	27	80,000	13.75	14.75
Atlantic.....				12½	13	12½	29½	40,000	-----	-----
Aztec.....						1	2½	40,000	-----	-----
Calumet & Hecla.....	{ \$5 Fe. \$15, M'y, Aug., Nov. } \$3 Feb.; \$3 Aug.	174¾	185	170	295	200	260	100,000	12.00	12.00
Central.....		27	35	24	43½	35	52	20,000	5.00	5.00
Copper Falls.....		¾	3½	12½	8¾	5	20	20,000	38.50	42.50
Copper Harbor.....								20,000	-----	-----
Duncan (silver).....		¾	7	2½	7	1½	5½	60,000	5.00	5.00
Franklin.....		5	8	4	31	10½	50	40,000	16.00	16.00
Huron.....						3	15	40,000	-----	3.00
Madison.....						1	3¾	40,000	3.00	3.50
Mesnard.....				1½	5	1	5	20,000	8.50	8.50
Minnesota.....				2½	5½	2½	9	20,000	21.80	22.30
National.....				1	7½	1½	7½	40,000	8.00	10.00
Osceola.....	{ \$1½ Jan. 1, \$1½ } Apr. 30, \$1½ } Oc., \$1 Jan. '82 }	9	17	10	35	30	48	50,000	17.60	17.60
Pewabic.....		1	2	20	40	11½	69½	40,000	21.25	21.25
Phoenix.....		5	10	5	6¾	1½	16	40,000	33.00	39.00
Quincy.....	{ \$5 Feb. 15, \$3 } Aug. 22..... }	10½	41¾	10	33½	22	48	40,000	10.00	10.00
Ridge.....		1	2	75	9½	3	10	20,000	20.00	20.00
Silver Islet.....		1½	54	20	65	11	55	40,000	2.50	4.50
Star.....				1½	2½	1	5	40,000	14.25	14.25
St. Clair.....				25	1½	-----	-----	40,000	-----	-----

## LAKE SUPERIOR MINING COMPANIES.—Continued.

	1881.												1882.
Lake Superior Cop- per-Mining Com- panies.	January 1.	Jan. 1 to April 1.		April 1.	April 1 to July 1.		July 1.	July 1 to Oct. 1.		October 1.	Oct. 1 to Jan. 2.		January 2.
		Low.	High.		Low.	High.		Low.	High.		Low.	High.	
Allouez.....	5½	3	5½	3	2	3	2	1½	3½	3½	3	4	3¾
Atlantic.....	19½	12	19½	12	12	15.06¾	12	11	17½	14½	14	18	18
Aztec.....	1½	1	1½	1	75c	1	¾	50c	75c	50c	50c	50c	50c
Calumet & Hecla.....	258¾	235	258¾	239	201	245	230	210	232½	220	215	239	237
Central.....	42½	34	44	34	28	34	30	-----	-----	30	29	30	30
Copper Falls.....	16½	8½	16½	8½	5	10	5	2½	6½	5½	4	5½	4
Copper Harbor.....	50c	50c	50c	50c	-----	-----	50c	-----	-----	1	1	3	2
Duncan (silver).....	4	3¼	4¾	3¼	2	3½	2	50c	2	50c	25c	56¼c	25c
Franklin.....	18½	12	18½	12	10½	14	11	10½	13½	12½	12	15½	14½
Huron.....	6½	3½	7½	4	50c	4½	3½	3½	4½	3½	3	4½	4
Madison.....	1½	1	1½	1	40c	1	50c	-----	-----	50c	-----	-----	75c
Mesnard.....	1½	1½	1½	1½	50c	1½	50c	50c	1	-----	-----	-----	75c
Minnesota.....	4	2½	4	2½	-----	-----	2	-----	-----	2	-----	-----	2
National.....	2½	75c	2½	75c	25c	2½	2	2	2½	2½	2½	3½	3
Osceola.....	38½	35½	40	35½	30	35½	32	28½	32	29½	88½	33	31¾
Pewabic.....	24½	16	25	17	10	18	11	10½	15½	13	12½	17	16½
Phoenix.....	3½	2½	3½	2½	1½	2½	2	1½	2	1½	1½	3	3
Quincy.....	44	31½	45½	31½	31½	38½	36	32	40	38½	37½	51½	51½
Ridge.....	7	4	7	4	3	4½	3	3	4½	4½	3	4½	4½
Silver Islet.....	34	27	40	27	25	48	45	30	47½	30	18	41	21
Star.....	2½	1½	2½	1½	1	1½	1	-----	-----	¾	-----	-----	75c
St. Clair.....	3½	3½	3½	3½	-----	-----	3	-----	-----	2	-----	-----	2

INGOT COPPER.—Monthly Lowest and Highest Prices for a Period of Eight Years.

YEARS.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.		YEAR.	
	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Average.
1874.....	21 $\frac{1}{2}$	25 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	25 $\frac{1}{2}$
1875.....	21 $\frac{1}{2}$	25 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	24 $\frac{1}{2}$	25 $\frac{1}{2}$
1876.....	22 $\frac{1}{2}$	26 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	26 $\frac{1}{2}$
1877.....	22 $\frac{1}{2}$	26 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	25 $\frac{1}{2}$	26 $\frac{1}{2}$
1878.....	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	18 $\frac{1}{2}$
1879.....	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	21 $\frac{1}{2}$	17 $\frac{1}{2}$	18 $\frac{1}{2}$
1880.....	15 $\frac{1}{2}$	19 $\frac{1}{2}$	15 $\frac{1}{2}$	19 $\frac{1}{2}$	15 $\frac{1}{2}$	19 $\frac{1}{2}$	15 $\frac{1}{2}$	19 $\frac{1}{2}$	15 $\frac{1}{2}$	19 $\frac{1}{2}$	15 $\frac{1}{2}$	19 $\frac{1}{2}$	15 $\frac{1}{2}$	19 $\frac{1}{2}$	15 $\frac{1}{2}$	19 $\frac{1}{2}$	15 $\frac{1}{2}$	19 $\frac{1}{2}$	15 $\frac{1}{2}$	19 $\frac{1}{2}$	15 $\frac{1}{2}$	19 $\frac{1}{2}$	15 $\frac{1}{2}$	19 $\frac{1}{2}$	15 $\frac{1}{2}$	16 $\frac{1}{2}$
1881.....	19 $\frac{1}{2}$	23 $\frac{1}{2}$	19 $\frac{1}{2}$	23 $\frac{1}{2}$	19 $\frac{1}{2}$	23 $\frac{1}{2}$	19 $\frac{1}{2}$	23 $\frac{1}{2}$	19 $\frac{1}{2}$	23 $\frac{1}{2}$	19 $\frac{1}{2}$	23 $\frac{1}{2}$	19 $\frac{1}{2}$	23 $\frac{1}{2}$	19 $\frac{1}{2}$	23 $\frac{1}{2}$	19 $\frac{1}{2}$	23 $\frac{1}{2}$	19 $\frac{1}{2}$	23 $\frac{1}{2}$	19 $\frac{1}{2}$	23 $\frac{1}{2}$	19 $\frac{1}{2}$	23 $\frac{1}{2}$	19 $\frac{1}{2}$	20 $\frac{1}{2}$

Lake Superior Copper-Mining Companies.—Monthly Products.

MONTHS AND YEAR.	CALUMET AND HECLA.			MONTHS AND YEAR.		QUINCY.		OSCEOLA.		FRANKLIN.		PEWADIC.			
	1879-80.	1880-81.	1881-82.	Tons, lbs.	Tons, lbs.	1880.	1881.	Tons, lbs.	Tons, lbs.	1880.	1881.	Tons, lbs.	Tons, lbs.		
May.....	1,411	1,096	1,713	1,528	1,764	1,019	1,070	1,410	1,310	199	540	199	540		
June.....	1,326	188	1,737	953	1,763	898	None.	156	1174	180	959	132	1041		
July.....	1,397	105	1,672	1,069	1,635	1817	124	1920	160	813	130	1470	139	1055	
August.....	1,379	879	1,701	1,645	1,818	339	180	920	142	1735	211	363	141	176	
September.....	1,444	1,649	1,684	881	1,612	1437	180	765	165	359	180	1245	131	90	
October.....	1,446	482	1,750	822	1,722	1560	180	35	196	1750	53	196	1100	254	179
Six months.....	8,405	399	10,250	928	10,317	1070	763	1655	992	1394	709	46	792	480	457
November.....	1,617	320	1,655	1304	1,646	189	180	580	176	1255	115	812	128	230	489
December.....	1,737	1253	1,703	1570	1,627	201	200	550	147	873	137	580	130	59	61
January.....	1,751	1557	1,652	1927	1,507	1307	317	1250	147	1177	191	374	180	375	71
February.....	1,519	951	1,435	1835	1,485	1931	300	550	143	1850	151	496	201	737	172
March.....	1,733	164	1,710	1496	1,496	1931	338	1945	161	1031	207	1359	150	140	520
April.....	1,701	972	1,881	1797	1,797	1931	395	485	225	642	208	Est.	150	---	135
Year.....	18,465	1616	20,290	1137	---	---	2,430	575	1,981	1547	2,405	152	1,598	1335	1,623
Per cent.....	77.32	77.86	---	---	---	---	---	83.50	85.21	---	87.07	---	81.68	---	82.81
Ingot.....	14,277	1425	15,797	1300	---	---	2,036	1610	1,690	1061	2,105	1423	1,305	1533	1,344
do lbs.....	28,555,425	31,595,300	---	---	---	---	4,073,610	---	3,381,061	---	4,213,423	---	2,611,583	---	2,689,556

(a) Quincy: Mill not running in February, 1880, and only 14 days in January.

† Not official.

(b) Mill running only a few days.

## STATISTICS FROM VARIOUS SOURCES.

The following extracts, from mining journals, relating to the copper industry, are introduced:

## CENSUS REPORT ON THE COPPER INDUSTRY.

Until the Chilian copper fields rose into importance, the world depended on Cornwall for this mineral. In 1842 some Buffalo hunters discovered a rich mine in the Lake Superior region, which has yielded thousands of tons of copper. At present the world's production of copper is about as follows:

Chili and Peru, 34,000 tons; United States, 25,500 tons; Australia, 14,500 tons; Russia, 5,600 tons; England, 5,200 tons; and all other countries 19,000 tons, making an aggregate of 103,800 tons. The United States is the second copper-producing country in the world, and the census of 1880 will show that we produced over 25,500 tons of copper, or to be more exact, 51,091,188 pounds. This amount of copper would make a cube, whose edge would be  $45\frac{1}{2}$  feet, or, in other words, would cover 25.9 acres with a sheet one inch thick. The copper product has increased since the census of 1870, 116.41 per cent. in weight and 70.25 per cent. in value, the fall in price per pound, according to Prof. Pumpelly, being almost exactly accounted for by the rise in the value of the paper dollar. In 1870 the Lake Superior region produced 83 per cent. of the entire product; in 1880 it attained 89.71 per cent.

A curious fact, tending to show the increased skill in copper mining, and the extensive introduction of steam power and improved machinery, notably the drills driven by compressed air, is brought out by this inquiry. Though the product has increased 116 per cent., the number of employes has increased only 13.7 per cent., while the capital has increased 303 per cent., the horse power of the steam engines 119 per cent., and the consumption of material 136.5 per cent. The gain in production per hand is 90 per cent. The same labor which in 1870 produced 4,387 pounds of copper now produces 8,344 pounds.

The following table from the census report shows the copper product of the United States for 1880 in pounds of ingot copper, and the value of the products.

	Product pounds of copper.	Value of Product.
Michigan.....	45,830,262	\$7,979,232
Maine.....	83,080	10,115
Maryland.....	164,640	1,200
Missouri.....	230.77	25,730
North Carolina.....	1,640,000	350,000
Pennsylvania.....	476,508	5,630
Tennessee.....	Not reported.	
Vermont.....	2,747,894	469,495
Wisconsin.....	18,087	1,549
Colorado.....	5,764,460	Not reported.
Arizona.....		
Idaho.....		
Idaho.....		
California.....		

The production of the extreme western states and territories (Colorado,



Arizona, Idaho, California), as far as received by the census office, is 5,764,-560 pounds, or 11.28 per cent. of the amount produced in the eastern districts. Eleven new mines in Maine, Maryland, and New Hampshire, report the employment of 162 men, the payment of \$31,985 wages, and 7,650 for material consumed. They have spent \$658,570 for machinery, dead work, etc., but have produced no ingot copper. The returns from this class of mines are not included in above table. The value of the plant in Michigan is placed at \$5,275,185, and all copper mines in the United States at mineral produced which valued, depends, of course, on the averaged price of copper during a term of years, and on the expectation of productive life for each mine, is placed at \$24,116,300 in Michigan, and \$24,517,164 for the entire country, and total capital at \$30,417,551 for Michigan, and \$31,675,096 for the United States. As compared with the iron ore mining industry copper employs 80.53 per cent. less hands, uses 60.61 per cent. less value material, and represent 48.61 per cent. of the capital. The product of copper is worth 38.98 per cent. of value of iron ore mined, but it costs 39.92 per cent. as much in labor to raise it. The average monthly wages in copper mining is 49.98, against \$32.26 in iron ore mining, in addition to which the miner has the great advantage of more continuous employment. Copper mines involve the employment of skilled and high-priced labor.—*P. L. Gazette.*

A FACT THAT SHOULD NOT BE FORGOTTEN.

The mines of one county of Michigan—that in which this paper is published—have divided more money among their stockholders, during the eight months ending August 31, than the mines of any other single state or territory in the whole union. The dividend record of the Houghton county copper mines for 1881 stands as follows:

Calumet and Hecla.....	\$2,000,000
Osceola.....	225,000
Quincy.....	440,000

The copper mines of Houghton county, saying nothing whatever of the copper-producing industries of Keweenaw and Ontonagon, and the iron mines of Marquette and Menominee—have paid \$720,000 more than those of California; \$393,750 more than those of Colorado; \$1,310,000 more than those of Dakota; \$1,670,000 more than those of Montana; \$697,475 more than those of Nevada; \$1,539,000 more than those of Utah.—*Northwestern Mining Journal.*

The sales of mining stocks in New York for the week ending Saturday, February 18, amounted to 1,311,887 shares, in which not a single share of Lake Superior copper or iron mining stocks was included. Lake Superior mines paid their shareholders over \$6,000,000 in dividends during 1881, while all the gold and silver bonanzas of the east, west, north, and south, whose shares are the favorites with the Gothamites, paid only \$13,229,318. The mines that paid the Michigan dividends have an aggregate capital stock of less than \$9,000,000; those that paid dividends in other parts of the country have a capital stock amounting to millions.—*Northwestern Mining Journal.*

The New York Daily Stock Report of the 17th ult., gives a list of gold, silver, and copper mining companies in Arizona, California, Dakota, Maine, Nevada, and North Carolina, which have levied since January 1, \$1,921,900 in assessments, and collected, since their organization, a grand total of \$75,360,680. This total only, recollect, includes mines that have levie

assessments since January 1, 1881. Of the entire list, embracing 93 companies, 11 have paid dividends amounting to \$83,058,000, of which \$74,444,000 were paid by the California and Consolidated Virginia, which are now considered "busted bonanzas." Deducting the total assessments from the total dividends, it appears that the net surplus divided among stockholders has been \$7,698,000, or a little over ten per cent. on the capital collected by assessment.

Look on that picture and then on this: The Michigan copper mining industry, from its beginning in 1844 to the present time, has required in its development less than \$22,000,000, and has paid in dividends very nearly \$32,000,000, or about \$10,000,000 more than the entire capital invested.—*Northwestern Mining Journal*.

#### MICHIGAN METALS.

A comparatively small, narrow part of the State of Michigan, skirted its whole extent on the north by Lake Superior, and on the south, in large part, by Lakes Michigan and Huron, and known as the Upper Peninsula, in little more than a quarter of a century, has contributed to the realized mineral wealth of the country nearly \$300,000,000 in ingot copper, pig iron, and iron ores. Of this immense product the iron mines have furnished nearly \$130,000,000. Last year the copper product was in value about \$10,000,000, and the iron about \$18,000,000, making a total of \$28,000,000, while the promise for 1882, both for copper and iron, is that the product will be greater. A pretty good showing for a strip of wilderness, and there is to-day more iron in sight than ever before, more new mines than old ones, and more iron territory remaining to be opened and explored than has been explored up to this time, three acres to one.—*Mining Record*.

Five copper mines of Michigan have paid 36 96-100 per cent. of the total dividends distributed by 32 companies engaged in mining in ten states and territories; and 27 mines of all descriptions, in other states than Michigan, have paid 63 4-100 per cent.

From the beginning of mining operations in the Lake Superior copper region up to date, very nearly \$32,000,000 have been paid in dividends, from the earnings of mines all but one of which are to-day actively working, and most of them in better condition to produce copper than ever before in their entire history. There is in their several treasuries a surplus aggregating about \$5,000,000; their outlook at depths ranging from 500 to 2,700 feet is excellent; their product, as hitherto shown in these columns, was greater, with one exception, in 1881 than ever before in one twelve month; they have paid on a total paid up capital of \$6,261,000, dividends amounting, in exact figures, to \$31,899,742, an amount more than one-third greater than the total sum expended in the development of all the copper mines ever worked on Lake Superior, or more than 152 per cent. on the entire outlay.

The above is a brief history of the development of the Lake Superior copper district, so far as such development has occasioned an outlay of dollars and cents, and been productive of substantial returns. It is a plain statement of facts—a record that can challenge comparison with that of any other mining district in the United States.—*Northwestern Mining Journal*.

#### COLORADO GOLD VS. LAKE SUPERIOR IRON AND COPPER MINES.

There is still a large difference in favor of the Lake Superior iron mines, or rather iron mining companies. Referring to a statement made by the Chicago

Times that 17 Colorado mines, with an incorporated capital of \$63,700,000 had returned to shareholders \$3,141,750 (about 5 per cent.) in 1881, the Hancock Mining Journal says:

“Compare the aggregate capital of those 17 mines and the dividends paid thereon, with the capital of the undermentioned Lake Superior copper mines and the dividends paid by the same on the earnings of 1881.

	Capital stock.	Dividends.
Calumet and Hecla.....	\$2,500,000	\$2,000,000
Atlantic.....	1,000,000	80,000
Central.....	500,000	60,000
Osceola.....	1,250,000	225,000
Quincy.....	1,000,000	440,000
Total.....	\$6,250,000	\$2,805,000

“Dividends in one year equal to 40 4-10 per cent. on the aggregate capital stock of five companies.”

The Mining Journal can name three iron mining companies doing business in this Upper Peninsula with an incorporated capital of \$2,100,000, whose net earnings in 1881 were greater than those of all the gold and silver mines of Colorado. And yet we presume the Times item was published with a view of inducing the investment of more capital in Colorado mining! The showing is bad enough as it is; what would it be if the whole truth were to be stated, by giving a list of the hundreds of Colorado mines in the working of which millions have been expended, and from which shareholders have never received a single cent in return. There is no such dark side to the Lake Superior picture.—*Marquette Journal*.

#### CALUMET AND HECLA.

The Calumet and Hecla stands at the head of the world's mining enterprises, having paid more in dividends, in proportion to the investment, than any other mine of ancient or modern times. Twenty millions and a half in property and plant, on an investment little, if any, more than one million, is a record never beaten—never equaled, or likely to be. Neither California nor Australia, with their gold, nor Nevada or Colorado, with their silver, come near the pride of the copper region, and it is just now in bonanza again, having found the amygdaloid to reinforce its conglomerate wealth.

Operations on the manganese lode, near Copper Harbor, have been suspended for the present. Mr. McCandless, of Pittsburg, a part owner in the industry, and also representing the interests of others, arrived at Copper Harbor on the 17th inst., and will settle all accounts of the mine to date. A majority of the owners deem it advisable to make further investigations as to the value of the ore before proceeding further. The ore produced carries considerable copper and they are afraid it may be difficult to separate the one from the other.

Mr. J. F. Bennett, under whose direction the work has been conducted thus far, has been east for the past month, but is expected back soon. On his return he may decide to resume work at once. He is very sanguine as to the ultimate success of the enterprise, and does not anticipate trouble in separating the copper from the manganese.—*Hancock Journal*.



## A CHEERFUL VIEW OF THE BUSINESS OF MINING.

The unusual care with which mining properties are now examined before purchase, and the cautiousness of the investor, although in marked contrast to the condition a few years ago, indicates one of the most healthful and beneficial states of public sentiment for those who have properties truly valuable. Although the enthusiastic prospector, with a few samples in his pocket, who who has been dreaming of the hundreds of thousands of dollars that can be secured for his claim, may be rudely awakened upon his arrival in the eastern market, yet every true friend of the mining industry must see, in this return to the basis of business, a most hopeful sign for the future of mining, and the certain investment of intelligently directed capital in its direction. Mining has rapidly and successfully passed a number of trying periods, all of which were dangerous to its best prosperity and development, but each one has brought its sterling character and real worth before the people in a clearer and better light, until it is now generally understood that mining investments and mining developments in the direction of production is the only legitimate line of activity, and that all the intelligently directed effort to this end has ever proved substantially and permanently profitable. We confess that the people have paid a large price for the wisdom they have learned, but it is valuable knowledge now they have obtained it.

Mining, under all the disadvantages and obstacles, natural and artificial, that have been thrown around it, through all the epochs of excitement, ignorance, and mismanagement, dishonesty and speculation, has at last revealed a place where it is beginning to be better understood and comprehended in its true light than ever before. A mine and a farm are found to be much alike in regard to the object of improvement and development, which is production. Bread and bullion, the two great motors of human activity, the two strong staffs of life, do not grow ready made. Both are the result of time, capital, labor, and intelligence, hence their real worth and value. Men are beginning to perceive this fact, and are returning from their expensive chase after a glittering *ignis fatuus* to find that mining is a plain, substantial, solid, and permanent reality, partaking largely of the character of the enduring rock and eternal mountains which generally surround the depósitos of mineral wealth. Readjusted to a working and business basis, mining may be robbed of much of the romance and gorgeousness with which it has been clothed by ignorant and designing persons; it will lose much of its speculative and uncertain aspect, but every true friend of this colossal industry will rejoice to see all those false and deceiving trappings torn away, so that mining may stand in her own rude and simple raiment upon the solid rock of truth, a giantess of strength and power, a stern but beautiful queen, magnificent in the grandeur and wealth of her mighty kingdom, in which new states and massive industries will be born, to grow and flourish in the sunshine of a perpetual prosperity.—*Mining Review*.

## STATISTICS OF THE PRODUCTION OF THE PRECIOUS METALS IN THE UNITED STATES.

The plan followed by the Census Bureau has been to try to secure individual returns; but many causes tend to render this method a difficult one. It was found to be impracticable to do more than obtain returns from the larger producers. In some instances, well-based and careful estimates were sub-



mitted by experts, covering aggregates of a large number of small mines for whole districts.

Even with greatly increased facilities, says Mr. King, there were many gaps in the testimony, which had to be filled out by estimates derived from other data than those collected directly by the experts. Where such estimates have been applied in the tabulation, they have been indicated by an asterisk (\*). In all cases a careful scrutiny has been exercised in the selection and comparison of material. It is believed, in view of the more extended and fuller details accessible, as compared with previous researches of the same nature, that the results reached in this compilation are as close an approximation to absolute accuracy as it is possible to attain without a far greater expenditure of money and time than the subject demands.

The total product of each State and territory, including the silver contents of placer gold, appears in the accompanying table, which shows the aggregate bullion output of the United States for the census year.

The figures given in the table are of assay values, and are therefore considerably higher than the actual market value. Disregarding express charges, commissions, and cost of refining and coining, there is still a large deduction to be made for this discount, in estimating the cash value of the bullion to the producers. Assuming the gold to have brought on the average \$20 per troy ounce and the silver \$1.12½ per troy ounce, the cash received would have been \$32,394,794 for the gold, \$35,772,160 for the silver, and \$68,166,954 total. The loss to the miners, as compared with the full assay value, would therefore have been \$984,869 on the gold, \$5,338,797 on the silver, and \$6,323,666 altogether, or about 1-34 of the full gold-coining value, over ½ of the nominal silver value, and over 1-12 in all, during the single census year. While there is no regular discount on gold, the large amount of placer gold sold at an undervaluation renders the average price assumed a probable one. The price for the silver is an estimate of average local rates for the year.

The bullion product of the deep mines of the United States for the year under review amounted to 35 tons 900 pounds avoirdupois (1,033,974.6 ounces troy) of fine gold, and 1,087 tons 900 pounds avoirdupois (31,717,297) ounces troy of fine silver. That of the placer mines weighed 19 tons 1,824 pounds avoirdupois (580,766.6 ounces troy) in fine gold, with which were alloyed 2 tons 1,498 pounds avoirdupois (80,177.3 ounces troy) of silver. The total weight of fine bullion was no less than 55 tons 724 pounds avoirdupois (1,614,741.2 ounces troy) of gold, and 1,090 tons 398 pounds avoirdupois (31,797,474.3 ounces troy) of silver. These huge figures may be better grasped, perhaps, by considering that the gold represents five ordinary car-loads, while a train of 109 freight cars of the usual capacity would be required to transport the silver. Historians have stated that during the early Spanish occupation whole galleons were freighted exclusively with silver from the mines of Mexico and Peru. This would hardly seem to be an exaggeration, in view of the fact that the present annual product of the United States would suffice to form the full cargo of a large modern vessel.

In addition to the returns received directly from the mines, there are several minor points to be included in the total yield. A larger item than it is usually considered to be is the annual hoarding of rich specimens. This is not accounted for in the mine production as reported. While it is impossible to state the actual amount thus absorbed with any degree of precision, a

careful estimate would place the value of the gold nuggets and ore annually added to the cabinets of collectors at not less than \$150,000, and that of the silver ore at about \$50,000. This, in view of the great number of mineral collections maintained throughout the mining territory, is certainly not an over-estimate.

There is also quite an extensive manufacture of gold quartz into jewelry and souvenirs, particularly in San Francisco. The value so absorbed probably does not fall short of \$50,000 annually. In 1870 the United States Mining Commissioner estimated the amount of gold hoarded as specimens or worked up by local jewelers at \$400,000. The same authority, at that period, estimated the annual loss of gold dust in handling as currency at \$100,000. As the practice of using dust for money has almost disappeared, the amount so lost is now very small.

Another indefinite quantity is the value of precious metal lost in melting, in assay grains, etc. Summing up the estimates for these additional items, the following result is reached :

	Gold.	Silver.	Total.
Bullion product shown in preceding tables...	\$33,379,663	\$41,110,957	\$74,490,620
Estimated value of specimens hoarded.....	150,000	50,000	200,000
Estimated value of gold quartz made into jewelry and souvenirs.....	50,000	-----	50,000
Estimated value of gold dust lost in handling as currency.....	10,000	-----	10,000
Estimated loss in melting and assaying, assay grains, etc.....	20,000	10,000	30,000
Total.....	\$33,609,663	\$41,170,957	\$74,780,620

#### DIVIDENDS PAID FROM AMERICAN MINES IN 1881.

Name of Company.	Location of mines.	Amounts paid.
Ætna, silver, lead.....	Colorado.	\$66,667
Alice, silver.....	Montana.	400,000
Black Bear Quartz, gold.....	California.	24,000
Bonanza Developing Company, silver.....	Colorado.	135,000
Boston and Montana, gold.....	Montana.	200,000
Brown and Urton, silver.....	Nevada.	8,333
Bulwer Consolidated, gold.....	California.	10,000
Calumet and Hecla, copper.....	Michigan.	2,000,000
Catalpa, silver, lead.....	Colorado.	120,000
Central, copper.....	Michigan.	120,000
Consolidated Gold Mining Company of Georgia, gold.....	Georgia.	32,000
Copper Queen, copper.....	Arizona.	150,000
Christy, silver.....	Utah.	24,000
Chrysolite, silver, lead.....	Colorado.	500,000
Deadwood-Terra, gold.....	Dakota.	480,000
Dunkin, silver, lead.....	Colorado.	110,000
Eureka Consolidated, silver, lead.....	Nevada.	225,000
Evening Star, silver, lead.....	Colorado.	500,000
Exchange, silver.....	Nevada.	15,000
Father De Smet, gold.....	Dakota.	200,000
Gagnon, silver.....	Montana.	5,000

DIVIDENDS PAID FROM AMERICAN MINES IN 1881.—*Continued.*

Name of Company.	Location of mines.	Amounts paid.
Gem, nickel.....	Colorado.	\$3,750
Glass-Pendery, silver, lead.....	Colorado.	25,000
Gold Stripe, gold.....	California.	67,500
Grand Central, silver.....	Arizona.	200,000
Great Western, quicksilver.....	California.	25,000
Green Mountain, gold.....	California.	109,375
Hecla Consolidated, silver.....	Montana.	90,000
Hibernia, silver, lead.....	Colorado.	120,000
Homestake, gold.....	Dakota.	360,000
Horn-Silver, silver, lead.....	Utah.	300,000
Idaho, (Grass Valley), gold.....	California.	263,500
Indian Queen, silver.....	Nevada.	51,500
Inyo Consolidated, gold.....	California.	40,000
Iron Silver, silver, lead.....	Colorado.	500,000
La Plata, silver, lead.....	Colorado.	180,000
Leadville Consolidated, silver, lead.....	Colorado.	20,000
Moore Mining and Smelting Company, silver, lead.....	Colorado.	36,000
Morning Star, silver, lead.....	Colorado.	75,000
Napa Consolidated, quicksilver.....	California.	90,000
Navajo, silver.....	Nevada.	25,000
New York Hill, gold.....	California.	100,000
North Belle Isle, silver.....	Nevada.	15,000
Northern Belle, silver.....	Nevada.	387,500
Oetario, silver.....	Utah.	800,000
Osceola, copper.....	Michigan.	225,000
Plumas, Eureka, gold.....	California.	135,468
Plumas Mining and Water Company, gold.....	California.	7,500
Polonia, silver.....	Michigan.	12,000
Quicksilver, preferred, quicksilver.....	Nevada.	396,945
Quicksilver, common, quicksilver.....	California.	128,446
Quincy, common.....	California.	320,000
Richmond Consolidated, silver, lead.....	Nevada.	788,292
Rising Sun, gold.....	California.	25,875
Robert E. Lee, silver, lead.....	Colorado.	50,000
Robinson Consolidated, silver, lead.....	Colorado.	400,000
St. Joseph, lead.....	Missouri.	60,000
Sierra Buttes, gold.....	California.	78,125
Silver King, silver.....	Arizona.	300,000
Silver King, silver.....	Colorado.	50,000
South Yuba Water and Mining Company, gold.....	California.	120,000
Spring Valley, gold.....	California.	50,000
Standard Consolidated, gold.....	California.	975,000
Starr-Grove, silver.....	Nevada.	120,000
Stormont, silver.....	Utah.	20,000
Tip Top, silver.....	Nevada.	100,000
Tombstone, silver.....	Arizona.	600,000
Vizina, silver.....	Arizona.	80,000
Western (Contention), silver.....	Arizona.	775,000
Yuba, gold.....	California.	8,000
Total.....		\$15,034,776

Total amount paid by gold mines.....	\$3,286,343
Total amount paid by silver mines.....	4,213,333
Total amount paid by silver and lead mines.....	4,015,959
Total amount paid by copper mines.....	2,815,000
Total amount paid by quicksilver mines.....	640,391
Total amount paid by lead mines.....	60,000
Total amount paid by nickel mines.....	3,750
Total.....	<u>\$15,034,776</u>

Amounts paid by mines located in the States and territories are as follows:

Arizona.....	\$2,105,000
California.....	2,654,734
Colorado.....	2,903,417
Dakota.....	1,040,000
Georgia.....	32,000
Michigan.....	2,665,000
Missouri.....	60,000
Montana.....	695,000
Nevada.....	2,035,625
Utah.....	844,000
Total.....	<u>\$15,034,776</u>



*Bullion Product of the United States for the Year Ended May 31st, 1880.*

STATE OR TERRITORY.	DEEP MINES.				PLACER MINES.				ALL MINES.			
	Gold.		Silver.		Gold.		Silver.		Gold.		Silver.	
	Ounces.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.
1 Alabama.....	62.9	1,301	---	---	---	---	---	---	1,614,741.2	33,379,663	31,797,474.3	41,110,957
2 Alaska.....	---	---	---	---	---	---	---	---	---	---	---	---
3 Arizona.....	8,802.6	*181,966	*1,798,722	*2,325,568	287.9	5,951	389.4	51	10,253.8	*10,253.8	38.4	51
4 California.....	414,571.7	8,569,959	837,354	1,083,616	*1,451.2	*23,999	*198.8	*257	829,676.7	17,139,941	*1,798,920.8	*2,325,525
5 Colorado.....	125,685.7	2,598,153	16,547,913	19,145,066	4,921.9	8,280,982	52,804.2	68,271	130,607.6	2,699,898	580,158.2	1,160,887
6 Dakota.....	157,489.8	3,254,984	54,577	70,563	2,460.3	50,859	1,052.8	1,361	139,920.1	3,305,843	12,800,119.8	16,549,274
7 Georgia.....	685.3	14,166	---	---	3,284.5	66,863	193.1	250	51,770.1	70,813	54,770.1	70,813
8 Idaho.....	29,025.4	600,069	347,676	449,519	42,592.8	879,614	11,633.1	332	3,919.8	81,029	256.6	332
9 Maine.....	145.1	2,999	5,569	7,200	10,199	---	---	---	71,578.2	1,479,653	359,309.1	464,550
10 Michigan.....	---	---	*20,000	*25,858	---	---	---	---	145.1	2,999	6,369.0	7,200
11 Montana.....	31,098.4	642,861	2,240,597	2,896,869	56,255.6	1,165,006	6,341.4	8,199	87,354.0	1,805,767	*20,000.0	*25,858
12 Nevada.....	234,050.0	4,838,243	9,614,230	12,430,239	*2,418.7	*49,999	*331.3	*428	2,246,938.4	4,888,242	2,246,938.4	2,905,068
13 New Hampshire.....	532.1	10,999	12,375	16,000	---	---	---	---	236,498.7	4,888,242	9,614,561.3	12,430,667
14 New Mexico.....	2,387.5	49,354	303,455	392,337	---	---	---	---	532.1	10,999	12,375.0	16,000
15 North Carolina.....	5,627.7	114,267	77	100	*226.7	*1,688	*31.0	*40	2,387.5	49,354	303,455.0	392,337
16 Oregon.....	8,289.8	171,365	15,165	19,972	44,811.5	926,336	6,331.2	8,196	5,754.4	118,953	108.0	140
17 South Carolina.....	314.4	6,499	---	---	316.4	*6,541	*43.3	*56	53,011.3	1,097,701	21,496.2	27,793
18 Tennessee.....	96.7	1,998	---	---	---	---	---	---	630.8	13,040	43.3	56
19 Utah.....	13,138.0	271,687	3,695,433	4,743,915	967.5	*20,000	*132.5	*171	96.7	1,998	3,068,565.5	4,743,087
20 Virginia.....	450.9	9,321	---	---	---	---	---	---	14,105.5	291,587	---	---
21 Washington.....	812.7	16,800	---	---	5,756.6	*119,000	*788.6	*1,019	450.9	9,321	---	---
22 Wyoming.....	837.9	17,321	---	---	---	---	---	---	6,569.3	135,800	788.6	1,019
	---	---	---	---	---	---	---	---	837.9	17,321	---	---

\* Estimated.

## COPPER SMELTING WORKS.

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One of the most important enterprises connected with the Lake Superior copper production are the smelting works at Detroit and Portage Lake. Both establishments belong to the same company, and the Detroit works were started contemporary with the origin of copper mining on the lake, and the operations of the company have kept pace with the growth of that industry. The operation of smelting copper began in Detroit in 1850, and its inauguration is due to Mr. John R. Grout, who has also, until his recent death, continued in the management of the business. A smelting house, reverberatory furnace and other fixtures were built. Without being smelted the copper would be of little avail. It comes from the mine in masses, or from the stamp mill in an impure state, the masses, barrel work, and stamp work being 90 % to 60 % copper. The masses are shipped in bulk, if too large to go into barrels; the smaller portions, including the particles from the washers and slime huddles are packed and sent in barrels. The barrels are graded according to the degree of purity of the contents, from 1 to 5; they are weighed at the mine, as are also the masses sent in bulk, and the weight of each and name of the mine stamped upon the package or mass.

At the smelting works the shipment, upon its arrival, is invoiced and credited to the company sending it, and is then smelted in the order of its receipt. Each package of stamp mineral is sampled for assay when it is opened to be put into the furnace. After it is smelted, the product is weighed and returned to the company. The smelting of the mineral of each mine is done by itself.

The melted copper is drawn off into moulds, the castings thus made being termed ingots, cake and bar. The terms indicate both shape and quality, and are made to suit the general use to which the metal is to be subsequently put. Ingot is used in making the several alloys of copper as combining it with tin, zinc, etc., while the cake and bar go to the rolling mills, etc., and are made into sheets and wire, etc., and used in the manufacture of the numberless articles to which this metal is especially adapted.

The smelting furnaces that were first employed were the Welsh reverberatory air furnace, and the common cupola blast furnace, the former being used for reducing the mineral, and the latter for separating the final copper from the slag; but as in all metallurgical processes the comparatively primitive methods and apparatus thus employed have undergone great changes. The quality of the product was below the standard desired, and a residuum of copper was also run off with the slag.

The reverberatory furnace was altered so as to convert the coal into gas, and then to ignite the gas by passing through it currents of highly heated atmos-

pheric air, the purpose being to attain a powerful and steady heat, and equally diffused throughout all portions of the burden, thus tending to produce a more uniform quality of metal.

The elliptical form was adopted for the cupola, with the usual blast furnace bosh, and as in the blast furnace the melting of the tuyère, and the too rapid cutting off of the hearth is prevented by the water pipes, which draw off the heat.

The works of this company are by far the most important in the country, and the company has done more to bring the business of copper refining to its present degree of perfection than all other similar works combined. The officers and operatives are skillful and experienced in the business, and the company has commanded large capital. The works at both places have been remodeled and enlarged from time to time as increase in the business, or changes and improvements required.

The Detroit works are situated on the Detroit river in that city, and comprise two large brick smelting houses, in one of which are two reverberatory furnaces, and in the other there are three. A suitable structure also contains two cupola furnaces with blowing engines, etc. The entire plant in this city covers six acres of ground, including the wharf, which is 250 feet in length. The capacity of the works here is 12,000 tons per annum. Another furnace is being added.

The works at Portage Lake, Hancock, were built in 1860. They occupy a narrow strip of frontage on the lake, between it and the Quincy hill, which rises up to the north. Here are two stone buildings, each one containing four reverberatory furnaces, and a building containing three cupola furnaces; also there are three additional reverberatory furnaces and one cupola. Besides these there are, of course, the engine house, machine shop, warehouses, offices, sheds, etc. These works have a capacity for smelting 28,000 tons of mineral per annum. In 1867 the works at the two places were united under one company, the Detroit and Lake Superior Copper Company.

It is probable at an additional cost, that the company operates works at two different points, but these works originally belonged to different organizations. Each point has its advantages, and at present there is but little, if any, difference in the cost of reducing per ton, between the two places. The following table shows the number of tons reduced by this company:

	Tons.
1855.....	2,895
1860.....	5,533
1865.....	6,631
1870.....	12,700
1875.....	18,019
1879.....	21,080
1881, at Portage Lake.....	25,000
1881, at Detroit.....	11,000

This company has long been identified with the Lake Superior copper interests, and during the past dozen years has smelted all the copper produced except a small amount, which is smelted at the works of C. G. Hussey & Co., of Pittsburg.

The officers are C. H. Carter, President, Waterbury, Conn.; F. J. Kingsbury, Secretary; Horatio Bigelow, Treasurer; J. R. Cooper, Manager.

The works of C. G. Hussey & Co., of Pittsburg, antedate those of Detroit by about two years. They were established at about the time the Cliff Mine began its operations, by Dr. Hussey and Dr. T. N. Howe, who were chief

owners in the Cliff. After some preliminary experimenting, these gentlemen in the spring of 1848, erected in Pittsburg, for the Pittsburg and Boston Company, two English reverberatory furnaces, similar to those used in Wales, for smelting copper—similar to that now used by Dr. Hussey, except that it is larger. These works now comprise one reverberatory furnace for the treatment of rich slag, and one ordinary cupola furnace, for the treatment of the slags from the reverberatory slag furnace. These works are conveniently situated to obtain coal, but are too far away from the copper mines. The only mineral now refined at these works comes from the Mass and adjacent mines.

#### LAKE SUPERIOR NATIVE.

The Lake Superior Native copper is an important business enterprise started at Hancock in September, 1880. The officers of the company are Ed. Ryan, President, Hancock; T. E. Stewart, Vice President; R. Uren, Secretary and Treasurer.

The works are known as the Rolling Mill, and the company are using 40 tons of copper per month in the manufacture of copper sheathing for braziers, locomotives, etc., and pressed copper bottom, etc. The company is meeting with all the success that was anticipated, and the business seems to be one of importance.



SLATE.



## SLATE.

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### BAY SLATE COMPANY.

It will be remembered that the Huron Bay Slate Company, which began work in 1872, ended its career, as did also that of its neighbor, the Clinton Slate Company, in complete ruin. The panic came on soon after the companies were fairly started, which with previous unfortunate management, caused the disaster of what should certainly be a successful undertaking.

Subsequently the property owned by the Huron Bay Slate and Iron Company, the Clinton Slate and Iron Company, and the Superior Slate and Mining Company, was purchased by a party of gentlemen from Jackson and Lansing, Mich., who have organized the Michigan Slate Company, and transferred to it the lands and property formerly possessed by the three previously mentioned companies. This estate comprises 6,300 acres of land in T. 51, R. 31, and extends to the shore of Huron Bay. The capital stock is \$500,000, divided into 20,000 shares. Of this capital stock \$400,000 has been paid up, leaving \$100,000 to be called in as the needs of the company may require.

The officers are: James M. Turner, President, Lansing, Mich.; W. K. Prudden, Secretary and Treasurer; J. M. Turner, S. F. Seager, S. L. Smith, Lansing, Mich.; C. R. Knickerbocker, W. D. Thompson, Jackson, Mich., Board of Directors.

The new company began work at the quarry in the fall of 1881, and have thus far built a new stone engine house, and placed in it a 75-horse power engine, for hoisting and pumping; have built a small saw mill to obtain, for immediate use, the timber and lumber required for repairing the buildings and erecting new ones, etc. The tramway has been overhauled and repaired, and on a portion of the way heavier rails put down to replace those formerly used. The dock has been also rebuilt, and the quarries are supplied with modern slate tools and machinery. In fact a good degree of preparation has been made to get out a considerable product the coming year. The company claim to have orders from New Orleans to the Pacific for this slate, to be used in covering public buildings where first-class slate is required. The new State capital building of Texas is to be covered with it, and several other important edifices, including the new University Library building at Ann Arbor.

The slate is receiving high praise everywhere. Good architects and judges pronounce it the strongest, clearest in color, and the most durable of any produced in this country. Its cleavage planes are very true, so that the slates lie very perfectly and even, forming a smooth, durable roof.

There is no reason to doubt the existence of a practically inexhaustible

deposit of most excellent slate rock, so situated as to be readily mined and manipulated, and got into market as cheaply as can be done elsewhere.

The company is said to be composed of gentlemen who possess almost unlimited capital, and who are likewise thoroughgoing, practical business men, who are nearly certain to carry on the business successfully, and in the not distant future to make the Huron Bay Slate product one of the chief industries in the Upper Peninsula.

As it may be of public interest and value, the report of Mr. N. A. Litchfield, of Vermont, obtained through the courtesy of Mr. S. L. Smith, is herewith given :

CLEVELAND, O., June 17th, 1880.

MESSRS. WM. BINGHAM AND AMOS TOWNSEND, *Trustees*, CLEVELAND :

GENTLEMEN—Before expressing an opinion as to the merits of your Slate Property, I beg leave to say a few words in relation to my appearance in this case.

In the year 1874 I was visiting your city, and during my stay was called upon by T. J. Towson & Co. to pass my judgment upon some slate then on the dock, that but a short time previous had arrived from your quarry.

My impression of your slate at that time was not favorable except as regards color and metal, and I so expressed myself, and from that time, with the accounts I have received in relation to the progress made in developing, down to the present examination of the same, I was forced to believe the same opinion I entertained respecting the slate quarries of the east was applicable to your case, and it was with serious misgivings that I was induced by my friend Towson to enter upon a more minute investigation of your property and its advantages, and I should have declined the invitation tendered by you but for Mr. Towson's representing his friends were interested, and were desirous of obtaining the opinion of a disinterested person.

I consented to act, and though my opinion may or may not be in accord with your interests, of which I know nothing, whatever I may say in relation to the matter is after mature deliberation, a personal examination and careful investigation with the means at hand, and without fear of contradiction by any one of truth and experience.

Pretending a positive knowledge of what there is in this vein of slate would be foolishness on my part, but taking the surface indications as a guide, which govern every one in their calculations, I am enabled to form some opinion of its purity and greatness, and from the quarries now opened this opinion is strengthened by the knowledge gathered relative to the beds, joints, seams, cleavage, quality of the rock, course of the vein, dip of the stone, etc., and which opinion so nearly agrees with that of C. E. Wright, Esq., Commissioner of Mineral Statistics for the State of Michigan, that I am pleased to quote his words. After explaining the formation of slate in the Marquette district and the objection to it for practical purposes, he says: "In the Huron Bay district slate fully equal, if not superior to the best eastern slate has been found, and is now produced at two quarries. The slate formation in these quarries forms a wide belt and extends over a portion of the Huron mountains. It consists of several strata or narrow beds of good slate and slate rock. The cleavage or splitting planes of the slate dip very uniformly to the south; but the natural bedding is in broad anticlinal and synclinal waves which have a trend of nearly east and west, and a consequent dip to the south or north, as the case may be."

He then speaks of the "Huron Bay quarry and the expensive error made in its opening." I cannot quite agree with him in this, as I consider it was ignorance, as any man possessing a knowledge of slate sufficient to superintend a quarry should know the difference between the bedding planes and its cleavage. I make this statement as an expression of my belief that the property was worked at that time, and if I mistake not, has been since, by thoroughly incompetent managers; but I can readily understand Dr. C. Rominger's mistake in failing to discover the difference between the bedding and cleavage, when he visited the quarry, in the interest of the State, as State Geologist, relying as he did upon these men for information: but let me quote again from Wright's report, that you may notice the error, as he terms it.

"The bedding of the Huron Bay dips about 15° to the north, while the cleavage pitches about 30° south. In the Clinton the bedding dips about 12° to the south and the cleavage pitches about 30° to the south, or nearly conforms to the bedding."

From this you cannot fail to see the great difference in the two quarries, and note



the ignorance of the superintendent of the Huron Bay, at its opening. The cleavage of this rock I find to be true, excepting the bed in which are found what are termed ribbons. This bed is slightly harder than the others and liable to be bowingly inclined. Much of this stock could be worked advantageously in a mill, and by reasonable care could be turned into roofing slate, but from the appearance of the dumps has heretofore found a resting place there.

The joints and seams in the quarry are not regular, but fully up to the average of those in the eastern quarries, and from all indications, blocks of good size can be produced if less powder and more brains are assigned to the work.

Nothing can surpass the quality of the rock, and from my knowledge of slate rock throughout the country, I am safe in saying there is none equals it at the present time, as regards color or metal. The black slate of Maine, commanding \$6 to \$7 per square at the quarries, has not the color, but the quality is good. Vermont and New York have no black slate, and their green and purple slates, commanding \$2.25 to \$3.50 per square at the quarries, have not the confidence of architects and builders, as the color changes, and mars the appearance of a roof. Pennsylvania, the largest producer of black or blue slate, commanding \$3 to 3.50 per square at the quarries, is not in a position to furnish a slate, either in color or metal, equaling those I have seen at your quarries. Virginia, with her blue slate, commanding a price of \$5 to \$6 per square at the quarries, has not, unless recently placed on the market, a slate suitable for first-class work, on account of its thickness, uneven surface, and general make. California has yet to produce from her black quarries a slate larger than about 10 inches square, but the stock compares in color and metal favorably with yours. Canada, who cannot reach us on account of duty, can produce large quantities of blue slate, a small proportion being of good grade, but unlike yours in color or metal.

With these facts in view, and as the demand for black slate increases daily, while that for Vermont slate decreases, I can see no reason why the production of these quarries should not find a ready market.

In the examination of the thickness of this slate vein, at well as its length, I had not that time to devote to it I had wished, but commencing at the southwestern corner of Huron Bay, lot Sec. 33, thence to the east line, one-half mile, and from the south line of the lot Sec. 33 to Sec. 28, one half mile or more past Huron Bay quarry, I became fully satisfied of the quantity of slate, and with the advantage of having a ditch cut across the vein for some 500 feet or more, showing the rock, its clearness from flint, etc., I could not but feel impressed with its vastness and the years of labor necessary for its development. Here we have one-half mile in thickness and length of a slate vein, the like of which has never before been found in this country, and although this amount is sufficient for all practical purposes, I might add, it is stated by parties well informed, who have had more time to examine the ground than myself, that the vein has been traced for  $1\frac{1}{2}$  miles across it, and from the outcroppings seen by myself I should agree with them, which justifies me in asserting that its actual thickness is yet to be determined.

It is truly astonishing, and I return east satisfied in my own mind of your ability to produce sufficient slate for all the western country, and with the decided advantages you possess for low freights, quick transportation, etc., I do not hesitate to say it is but a question of time when Vermont and Pennsylvania will both have to look for a new outlet of their products.

To say much in favor of the work that has already been done there, I cannot, and I might at this point remind you of the expensive error in opening Huron Bay, and advise you that in any future working of your lands, it would be better to abandon this opening and start in another place at a comparatively small expense, when you understand that the successful working of the Huron Bay necessitates the removal of the larger part of the rubbish that has been made during its developments.

The Clinton having been opened to much better advantage is in a condition to produce much slate, the success of which depends upon men of experience, proper machinery, tools, facilities for shipping, and economy in all things.

The same judgment and discretion exercised in the working of your quarries, seems to have entered largely into the case of your houses, machinery, and in fact nearly everything there; even the tramway requires a small expenditure of money to make a continuous incline from the quarries to the Bay and put it in good condition, but with this accomplished, plenty of slate in the vein, produced at a fair price, made in a most approved manner, cheap freights and the business conducted on business principles, leads me to conclude that no field of enterprise in the Northwest

can offer better inducements for the safe investment of capital, with every indication of very large returns.

From this statement of mine, though simple it may be, I trust you will be enabled to form your conclusions of the value I place upon the property.

With this I am done, and it only remains for me to hope the day is not far distant when I shall learn of the opening up of the quarries and their success.

Yours obediently,

N. A. LITCHFIELD, *Hydeville, Vt.*

# IRON MINES.





## MARQUETTE DISTRICT, MAY AND JUNE, 1882.

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### THE JACKSON IRON COMPANY.

In the Commissioner's Report for 1880 the Jackson Company's mines are very fully described, and there is, apparently, but little to be said that would not be in reality a repetition of what has been heretofore stated. The experience of the past year at this great mine, embraces the same peculiar features that has characterized its record for many years, and what may be expected in the future. The mine is fruitful in surprises; however discouraging the outlook in any part of it may be, something favorable is sure to develop somewhere, perchance when least expected.

Captain Merry has so long been familiar with this location that he is never alarmed; he knows from experience that something will turn up, and that the explorations which he is constantly making by means of trial shafts, drifts, and cross-cuts, will result in finding the treasure which he seeks. He is familiar with the peculiarities of this contorted, twisted formation, and long familiarity has inspired him with faith in his ability to meet with and to overcome the difficulties which occur.

A year ago No. 7, the most easterly pit of the mine, seemed to be about exhausted of ore; now it is the most promising part of the mine. They had reached the wall upon all sides, and the bottom was only rock. A drift, 800 feet in length, to the northwest, and then bending around to the north, had been driven all the way in rock without discovering ore. Under these circumstances the outlook for No. 7 was not, certainly, very encouraging. However an upright shaft was started down from the bottom of the pit, which, after penetrating the rock for a distance of about 20 feet, came into ore and continued to a depth of 60 feet, when a chamber was cut out to the south, which proving to be also in ore of such excellent quality that it was concluded to cross-cut and test the deposit, the drift was continued to the south for 75 feet, and remained and terminated in ore. A drift was also opened to the north 100 feet, which also proved to be in ore. Under these circumstances the upright shaft was abandoned and a new one started from the surface, having an inclination downward to the south of 66°. This shaft has been completed to 150 feet in depth, provided with track and skip, and is now worked for hoisting the ore up in the pocket, which has also been built close to the north side of the pit and close to the main line of the railroad—(M. H. & O.).

From the bottom of this shaft a pit has been worked out to the south 100 feet in diameter, and the workmen are daily extending the area. No walls of rock have as yet obstructed the progress. On the south side and on the west the soap rock had been met with which, at first, seemed to indicate that a

limit had been reached; but penetrating this it proved to be of but limited thickness, and beyond the ore was found to continue as before.

On the east side a wall of jasper was also reached, and they really thought that here a limit was attained; but concluding to test the matter further they pushed into it and very speedily came again into a fine black slate ore. Fully half of the ore is left in the supporting pillars. The ore is very rich and pure; high in metallic iron and exceedingly low in phosphorus, but then no less could be said of the Jackson ore. It has far too long been a standard for excellence in the market to need commendation. In this pit it presents a very singular appearance, having all the indications of the action of water, showing innumerable holes, cavities, "vugs," etc., and the various discolorations which water occasions, yellow, ochereous, black, brown, blue, red, and green. From the bottom of the pit to the drift which above was run to the south is 40 feet, and for that distance it is all ore. Capt. Merry is about to begin to sink for another level. He says that if he had left the mine, and had afterwards been told of the finding of this great deposit of ore in this place, he would not have credited it; only actually seeing it could produce conviction. What makes the occurrence of this deposit more surprising is the fact that on the surface from the south margin of the open pit, the soapstone extends south 200 feet, and dips to the north. The south wall of the open pit is of this rock, extending down with all regularity and meeting the north wall, which is jasper, between which and the soapstone was the ore deposit, which has been worked out. The present discovery underlies both the soapstone and the jasper; both formations are cut off, and beneath them is the ore deposit; what has become of the rock is not satisfactorily apparent. One would think it were a fold; if so, it has been cut off, and the bottom and part to the north has been carried away. There is no return to the fold. There is, simply, a wall of this rock, dipping to the north at an angle of about 50°, and limited in both directions, at the surface and at the bottom.

The jasper dips to the south, on the north side of the pit, but in the jasper, which forms the east end of the pit, there are, possibly, indications of a fold. However, there are a great many knotty geological problems to be observed in the formation at the Jackson mine, and any experts who have the leisure, and who derive a pleasure in this sort of study, will find here in this location geological paradoxes that will tax all their skill to unravel.

No. 6 pit, which was fully described last year, continues now, as it was then, the best portion of the hard ore mine. It is looking fully as well as ever before; another level has been sunk, being 400 feet below datum. The vein has continued to widen, and now has a width of 25 to 30 feet, giving stopes in the ends of the drift, either way from the shaft, of 40 feet in height.

The success met with in No. 7 induces Capt. Merry to undertake a like exploration in old No. 1 pit, and he also inclines to the belief that the Pioneer Mine, the most westerly workings, will yet reveal deposits of an equal to any that this portion of the mine has heretofore afforded.

The Iron Cliff Company no longer obtains its ore in this mine for the Pioneer furnaces. The contract made 25 years ago with the Pioneer Iron Company, of which the Iron Cliff Company became possessed when the two companies consolidated, expired in April last (1882). This lease has proved a very advantageous one for the furnaces. Under it the company was permitted to mine its ore in the Jackson Mine, paying therefor a royalty of \$1 per ton of pig iron made; that is, for every ton of pig iron the furnaces turned out, \$1 per ton was paid to the Jackson Company.

A new enterprise has been inaugurated in which the Jackson Company is directly interested, and which promises to be of much importance to the city of Negaunee and of value to the iron industry. This is the undertaking to crush the rock in the waste dumps, and obtained from the jasper walls of the Jackson Mine, and to separate out and save the ore contained in the rock. An immense building to contain the machinery for the necessary manipulations is now constructing. The situation of this mill is 600 feet north of the mine, in the direct line of the railroad, which comes out from the tunnel, and is built against the side of the bluff, which rises to the north from the level of the small lake, which lies to the west, from which the necessary water is to be obtained. The size of the buildings is 116x180 feet, and from the level of the engine house to the top is about 100 feet. There are nine floors. The rock cars will be drawn up into the top of the building on an incline at the west end, and from the bins into which it will be dumped, it will be drawn out into the large 1,500 pound crushers, of which there are five; from thence the material will pass through the separators; all but the finer portion, which escapes, passes to the smaller breakers, placed upon the floor below; of them there are 10; thence again through separators and to the floor below to the rollers in which the rock is crushed to the requisite fineness, and finally goes into the washers, placed upon a succeeding floor in which the work of separating is completed. The company is called the Negaunee Concentration Company. It expects to work up 1,000 or 1,200 tons of rock per day, thus obtaining 300 or 400 tons of iron daily. For this rock the Jackson Company is to receive 45 cents per ton of iron made. The concentrators mine the rock themselves. It is said that the iron rolling mills will take the entire product. The South Jackson, joining the McComber, is looking extremely well. The product is a rich, manganiferous, soft ore, not so high in metallic iron as the Jackson hematite, but from its high percentage in manganese it has an especial value, and thus sells for nearly as much in market.

The mine produced last year about 25,000 tons of ore, and the total output by the Jackson Company was 118,930 gross tons. The aggregate product to date is 2,186,187 gross tons.

Capt. Henry Merry, who for upwards of 20 years has acted as agent, and has conducted the mining operations of the company, still continues in charge.

#### THE LAKE SUPERIOR IRON MINING COMPANY—(MAY, 1882).

This company enjoys the reputation of shipping more ore than any other company in Michigan or in the United States. The total output of its mines in 1881 was 262,235 gross tons, 200,000 tons of which were first-class ore, the remainder being made up of the second-class ore, the hematite and the Lowthian Mine's products. It is one of the oldest mines on the lake, and from 1857 to the present time the aggregate of its shipments amounts to 2,666,456 gross tons. The company owns 20,000 acres of land, mainly in T. 47, R. 27, on which are several valuable mines, in addition to those worked by the company. The others are worked as the National, New England, etc., on a lease from the company.

The Lake Superior Mine, proper, is in the city of Ishpeming, joining the Cleveland Mine on the west and the Barnum on the south. The several contiguous mines or pits on the location that are now worked are the A shaft, No. 3 pit, No. 2, No. 6, and No. 7, and the Hematite Mine, lying south of the others. Of these pits the most productive at present are Nos. 2 and 3.



A year ago A shaft was a wonder. It is the most easterly pit, and separated from the others by nearly 1,000 feet. The work during the last year has determined the dimensions of this deposit, and it proves to be an immense pocket or brace of ore, commencing immediately under the drift and having a depth, vertical, of 70 to 75 feet, and a maximum width of 111 feet, narrowing to the ends, giving an average width of 50 feet to 60 feet, and an average length of 105 feet. From this pit has been taken, in the last year, about 25,000 tons of ore. It will last two or three years longer, giving annually about the same product as last year. The remaining portion of the lens lies to the east, extending to beneath Main street. Four hundred and fifty feet north of this pit a hole was bored on the "base ball ground," 960 feet deep, which passed through 50 feet of ore in one body, 200 feet below the surface; from the pit a boring was made in the direction of this hole, which gave no intervening ore. This boring was followed by a second one at a greater pitch, but before reaching the hole the drill bit was lost and the work suspended. This latter boring is now following with a shaft, which will continue in the same inclination until the horizon of the ore is reached, when a drift will be opened to it, and the ore mined out in such manner as the situation shall develop. The length of this shaft will be, on the line of the boring, 270 feet; 200 feet are yet to be accomplished.

Another diamond drill hole is boring from the surface 250 feet east of the former one, which is down now 180 feet. The shaft, which is sinking, conforms nearly with the old one used in working the pit.

In Nos. 2 and 3 pits the ore is worked out, substantially, above the 240-foot level. In the 180 a drift connects with No. 6 pit, and in the latter, in this level, several diamond drill borings have been recently made, in one of which 36 feet of ore was found. A drill hole in the 240-foot level passed through 24 feet of No. 1 ore, and from No. 6 pit a drift is extending toward it. No. 6 pit is northwest of No. 3 pit, and is connected with it. The product has come from the 280 and 320-foot levels. The former level in No. 2 shows that the ore lies in an upturned fold or synclinal, giving it 2-foot walls and no hanging. On the north side the dip is to the south at an angle of  $65^{\circ}$  or  $70^{\circ}$ , and on the south wall the dip is to the north at an angle of about  $80^{\circ}$ . There is no immediate prospect, however, of finding a bottom. At the present rate of narrowing the deposit is good for five or six levels yet. This ore basin, if such it is, widens out to the west and has an inclination to the west.

At the east end the distance between the walls, as above described, is 90 feet, and at the west end of the workings this distance becomes 200 feet, from foot to foot. Between these walls is included three separate veins, running east and west nearly parallel with each other, each one having a well defined foot and hanging wall, and having about the same width, averaging 15 feet or 20 feet wide. The south vein is a little the narrowest, but it is the most regular. The north vein has been worked in this level a length of 800 feet; the middle vein 450 feet, and the south vein 600 feet.

The north foot wall vein is a continuation of No. 3 pit, and of the Barnum Mine; it connects with No. 3, which lies to the northwest 300 feet distant. The openings in the veins are of course connected by cross-cuts as required.

The 320-foot level has not been so extensively worked as has the 280. The veins lengthen to the west, each successive lift giving greater length as they go down.

In the 320-foot level, in No. 2 pit, are five important stopes: at the west end of the south vein, west end of the middle vein, and west end of the north



vein, and at the east end of the south and middle veins. In the 280-foot level, in this pit, are three stopes: at the west end of the south and middle veins, and at the west end of the latter.

There is a perceptible narrowing in the total width of the pit in the 320-foot level from the 280. The amount of ore remains, apparently, about the same. The squeezing out is in the rock, that in the upper level separates the veins of ore. The main drawback is, that in the absence of rock more ore has to be left in pillars, so that the yield may be to that extent the less. The veins in that level have been worked out to about the same length as in the other, for which the distances have been given. In this pit another lift has been sunk and opened for stoping, the 360-foot level, and the shaft has been lowered to the 400-foot level, but no openings have been made to that depth. In the 360 the veins are crowded together still more, showing a less amount of intervening rock, but an equal body of ore.

No. 3 pit is worked out in the levels above the 240-foot, and the main stoping now is in the 280-foot level; it is divided into a north and a south vein; the foot wall vein, the former, is worked out and they are now working in the hanging wall vein, which going east will connect with No. 2 pit; going west it is 50 feet wide; the south vein, which is stoped out, is 70 feet wide. In the west end of the vein is a magnificent stope, in this level, 120 feet long, 50 feet wide, and the full height of the level. It seems too good to be lost, but in the level below, the 320, it seems to hold all right. There is danger that the jasper foot may flatten out and cut off the deposit under. There are no indications of such an occurrence. The foot wall slopes at an angle of about 45°, and if it so continues there will be no trouble, but, as frequently happens, it may flatten and cut under the ore; but at any rate they are sure of the full body of ore, 120 feet, to the Barnum line, and reasonably certain of an equal fortune in the level below. The hanging is a chloritic schist. They are now mining in this pit, No. 3, 1,800 to 2,000 tons per month, all No. 1 ore.

They are also stoping in the 320-foot level, in this pit, and here will be taken out a large portion of the season's product. They are drifting toward the large stope described in the level above, and also are drifting south to the south vein; very large pillars are left, and are frequent. At some future time these, or some of them, may be removed, but at present, where there is so much heavy blasting and so many men, it is deemed best to make the roof very secure, even at the expense of a large amount of ore. The openings are pushed well ahead, giving as many stopes as possible.

Both pits tend to the northwest toward No. 6, and will in time come together at No. 6, so that the shaft, which is sinking at No. 6, will be, in time, the main working shaft of the mine. The shaft is being substantially made with that view. In the upper levels, as in the 140, in No. 2 pit, a good deal of second-class ore is taken out; 10,000 tons have been mined here in the last year, and the same amount, probably, will be taken out the coming year. The second-class ore obtained in the mine is as carefully selected as is the first-class. A market has been made for it, and it sells readily. It is sold under the name of Essex ore.

No. 6 is really an extension of No. 2 pit. It is the prolongation of the foot wall vein of No. 2, and is looking very favorable. Three diamond drill holes have been bored to the south from this pit, which passed through considerable bodies of ore. They are working in the 180-foot level.

No. 7 is the same as described last year, except that another level has been sunk, making three now in the 220-foot, though the levels here do not corre-

spond with those in the other pits. This latter level in No. 7 is called the 5th. The company is working 40 men to a shift in No. 7, and it is looking as well as heretofore.

The new engine house is a very substantial stone structure, in which has been placed the new machinery comprising a double engine each 24x48, and 4 hoisting drums each 12 feet diameter, 6 feet face, Lane's pattern, Akron, Ohio. These operate Nos. 2, 3, and 4 shafts; No. 2 is a double skip road. In this building has also been placed the straight line engine for supplying 16 electric Brush lights used on the surface in the engine house, trestle stock pile, etc.; it is not used in the mine.

A somewhat extended description of the system of mining practiced in the Lake Superior Mine may not be uninteresting, and applies, measurably, to all the other mines.

Mining work naturally begins with the opening of the mine; that is, the sinking of the shafts, driving the tunnels, sinking winzes, etc.; thence follows the breaking of the ore, tramping the ore underground to the shafts, hoisting the ore to the surface, tramping to the ore pockets, stock pile, or cars, and weighing.

The preparatory work in mines is begun soon after the close of navigation; but generally in all mines there is some portion of it where the opening work is continuous, going on simultaneously with the stoping of ore. This is the case in the Lake Superior, in No. 2 shaft, where the preparatory work never ceases, and as this is a typical part of the mine a full description of the work here will convey a sufficiently clear idea of the whole. No. 2 shaft was started 8x18 feet in size, measured inside of the timbers from the 140-foot level at an angle of 36° from the horizontal, and looking 65° S. W.; it was thus continued down 70 feet to where they drifted south and opened up the 180-foot level, in which they are now stoping in one or two places. Continuing the shafts about 100 feet further, they made a short cross-cut, striking ore and opened the 240-foot level, giving a 60-foot stope. Leaving some ground standing, they continued the shaft through a winze and drift about 70 feet, when they opened up the 280-foot level, and afterwards took out the ground left standing and brought the skip tracks down to this level. This work was done at various times and in different ways, requiring but little timber, the shaft being mainly in chloritic schist. From the 280-foot level it has been sunk in a regular and systematic manner. The work is under the superintendence of a competent man, whose gang of men consist of one machine runner and helper, and five fillers, one of whom is a miner. The drilling is all done during the day time, and the filling and hoisting is done by night; thus there is no interference in the work, and with one air drill enough ground is broken to keep the men busy through the night. All hitches are cut by the foreman and the runner, and the timber is put in place by the same gang of men heretofore mentioned.

As soon as a level is reached a drift is started, and when the drift and shaft are far enough advanced, so that no injury will be done to the timber work, a platform is put in and the skip track extended to this new level. The shaft and drift are continued on at the same time. As soon as the preparatory work is done, the new level is opened up by the regular mining force, and divided into its several stopes under the direction of an experienced mining boss, and at the same time the sinking of the shaft is pushed forward. In this way the company finds it can sink a good shaft at a minimum cost.

"A" shaft is sunk in much the same way except in the number of men,

having an additional force of fillers and keeping the machine going in two shifts, as the ground is much harder.

Winzes are sunk mostly by contract, the usual size being 6x6 feet. They are put down at such points as will give the best ventilation. A winze is partly made by raising, yet but little of the mining is done "over hand," *i. e.* breaking from the back or roof. They are usually sunk to a depth of 20 or 25 feet from the bottom of the level, and a raise is made from below to connect; much pumping and hoisting are thus avoided. The drifts are run with power drills, and are carried about 7x8 feet in size. The "dirt" is sent up, usually, "on company account," and as soon as the drift is about under the winze, an "inclining raise" is made of a height sufficient to connect with the "sink." The work is raised to some extent, to suit the place.

The work of breaking the ore is carried on under the immediate supervision of the shift bosses. It consists in drilling holes for blasts with power drills or by hand work, and in charging and firing the holes, barring the roof and sides of the chamber where the blast occurs.

The ore is mostly worked out by breast and back stopes, leaving a floor of about 10 feet thick to form the bottom of the level. This bottom is laid with railroad track on which the tram cars are run. This standing ground, in the bottom, also supports the walls and is measurably necessary to protection. At suitable distances, depending largely upon the character of the hanging wall, whether it be firm or treacherous, pillars are left for support. These pillars are about 30 feet diameter, and reach from level to level *i. e.* from the floor of a level to the roof, or they extend from foot to hanging wall with an arch below, thus leaving the opened ground in chambers, connected by the arches or short drifts, made through the pillars.

The drilling is nearly all done with power drills, each machine having its own set of tools, for which the "runners" are held responsible. All repairing, and extending of air pipes is done by a man kept by the company for that purpose, leaving the drill runners to drill the holes and to bar the ground after blasting. The blasting is done by the shift bosses, and an assistant who has charge of the powder and supplies, the different parties with oil, etc.

In a few places contracts have been let to break ore by the ton, but there are, at the present time, no such contracts in the mine. The aim is to have as large number of stopes as possible, so that as soon as a stope is cleaned up by the trammers, to put a machine to work in it, and have the ground broken at another stope to which to transfer the trammers. The drill will continue in a stope as long as the men can work to advantage, when it will be taken to another stope and the trammers set to work to clean up after the drill. The two sets of men are thus kept out of each others way, and there is also an advantage in planning the holes.

The "filling" and tramping to the skip is done on contract, by the ton. The fillers sort the broken mass into first and second-class ore, and take out the rock and tram it to the shaft, and dump it into the skip. The frames of the tram cars are made of hard wood; the body of the car is 26x54x19 inches; the sides are of  $\frac{1}{4}$ -inch iron; the bottom is double  $\frac{3}{8}$ -inch iron, strongly riveted with angle iron. They hold about one ton each, and when the tram is long they are provided with flaring sideboards. The tracks are made, and all repairing on them is done by or under the direction of a man whose business it is to attend to this underground work.

A man at the skip sees that the skip-road is clear and that the load is prop-



erly in, when he signals the engine-house to hoist, and also signals the scale-house what kind of ore it is, and from where sent; it is thus credited.

The skips are made of  $\frac{1}{2}$ -inch iron, 36 inches square, with double bottoms, and are 5 feet in length, holding from two to three tons each of ore. The skip ropes are  $1\frac{1}{4}$  inches diameter, made of steel wire. They require the attention of a rope splicer and an assistant, who make all splices and dress the ropes with tar or pitch as frequently as becomes necessary, to prevent rust.

The ore, after reaching the surface, is dumped into railroad cars, or into tram cars. If into the latter it is trammed to the pockets or to the stock pile. To handle the car requires one to three men, according to the amount of ore sent up in the skip, and the distance to tram, condition of the road, etc.

The tram cars are large and flat, made of wood heavily ironed and arranged to dump either at the side or at the end. A slope is given to the tracks so that the cars have a down grade out with the load and are drawn back with horses. All the ore is weighed immediately after leaving the shaft house.

#### SHAFTS.

No. 2 shaft dips south  $60^\circ$  west at an angle of  $36^\circ$ , and can be used at the 180, 240, 280, 320, 360, 400-foot levels. It is provided with a double track, made of 10x12-inch runners, on which are laid 60-pound steel rails. The number of skips hoisted in this shaft average 176 to 180 per day, or a skip every six or seven minutes.

No. 4 shaft dips south  $30^\circ$  west at an angle of  $75^\circ$ , and is used in the 280, 320, and 360-foot levels. Its size is 8x12 feet, furnished with a single track.

No. 3 shaft dips south  $61^\circ$  west, at an angle of  $47^\circ$  at the top, but increasing to  $59^\circ$  at the bottom. It can be used in the 240, 280, and 320-foot levels. Its size is 10x14 feet, and it is provided with a single skip-road and ladder-way, and one pump, the water mainly running to No. 2 shaft in the 240-foot level.

No. 6 shaft is 8x12 feet, and is only worked down to the 180-foot level, and has a single skip track. This shaft has its own ladder-way and pump. It dips north  $10^\circ$  west at an angle of  $46^\circ$ .

A shaft dips north at an angle of  $34^\circ$ , and is down 70 feet below the bottom of the open pit. It is 8x12 feet in size inside the timbers.

The yearly product of the different pits reckoned from May 1st, 1881, to May 1st, 1882, is as follows:

	Tons.
Old Mine, first-class ore.....	119,850
Old Mine, second-class ore.....	48,670
A shaft, first class ore.....	18,560
Summit, or No. 1 pit.....	19,520
Old Mine Hematite.....	44,460
Lowthian Mine.....	30,880

#### THE LAKE SUPERIOR HEMATITE.

The Lake Superior Hematite has proved to be a valuable mine, and there is every assurance of its continuing as good in the future as it has proved to be in the past. The mine is situated a few hundred feet to the south of No. 3 pit and a little to the east. It consists of a large open pit, beneath which are the underground workings. These, in the 220-foot level, have already, for a hematite mine, become somewhat extensive. In this level 40,000 tons were mined the last year. The length of the pit is about 800 feet, and at the west



end the width is 100 feet. The main pit is at the west end of the mine. This west end is 140 feet east and west by 161 feet north and south, having its roof supported by three or four immense pillars, aided by timbering. In the center a drift through jasper connects this part of the mine with the shaft. From the shaft to the southwest runs a drift 180 feet through the ore, a narrow vein. To the northeast from the shaft there are extended two drifts, which go around a large block of ground, left on account of its poor hanging; both are timbered drifts, and they come together at 100 feet from the shaft, where they again separate, the south drift continuing straight on, and the north one making a large bend to include a still larger block of ground than the one to the west of it. These drifts again come together at 180 feet from the shaft, to the east of it, from which latter point to the northeast 220 feet, was a large body of ore, which has been stoped out to an average width of 20 feet. From this latter chamber, 100 feet northwest of the shaft, a drift to explore the ground was run to the northwest 120 feet long, but it proved to be mostly in jasper.

The shaft is vertical, furnished with a double skip road, and has been sunk another 60-foot lift, to the 300-foot level, where the product of the mine for the coming year will be mainly derived. In this level a drift has been thus far run to the northwest 60 feet, and from the west side of the shaft to the north a drift runs 100 feet. There is to be found no reason to question but the 300-foot, and succeeding levels, will prove as favorable as has the 220-foot. Like most of the hematite mines, much timbering is required, and where such extensive underground workings exist, entered only by a single shaft, great care must be taken to avoid caving in. The hematite hoisting engine also operates "A shaft" by wire rope transmission.

#### THE LOWTHIAN MINE.

The Lowthian Mine, owned and worked by the Lake Superior Company, is situated about three miles to the south of Ishpeming.

A large open pit 250 feet long and 125 feet wide has been worked out, from the bottom of which the vein has been followed, and worked out underground. The vein is split up into three veins. The past year the principal mining has been done in the 240-foot level. The south vein in this level has been worked out 200 feet in length and to an average width of 35 feet. The middle vein averages 25 feet wide, and has been worked a length of 75 feet, and the north vein to about the same extent. Another 60-foot lift has been sunk and a new shaft is making, more nearly in the center of the mine. It was intended to have this shaft completed early in the spring of 1882, but unexpected delays have occurred, and the time of completing the shaft will be much extended, greatly to the hindrance of the mining work. The deposits pitch about 55° to the north, having a foot wall and hanging of jasper. The ore is a good quality of soft hematite, averaging 58.8 % metallic iron. The mine yielded 35,000 tons the last year (1881), but hardly that amount will be shipped the ensuing season on account of the delay occasioned in building the new shaft.

In the next level, 300 feet, a floor, or rather roof, of 20 feet, will be left, in order to have less pillars. A new pump has been added, an improvement much needed, and preparations are making to build a new stone engine house for the hoisting machinery, etc. When this is done, and the new shaft is completed the mine will be in good shape.

Section 19 Mine, which belongs to and was formerly worked by the Lake Superior Company, is now worked on a lease by the Saginaw Mining Company. The management remains as heretofore: C. H. Hall, Agent and General Manager; W. H. Johnston, Superintendent; John McEncore, Mining Captain; C. F. Howe, Mining Engineer.

THE CLEVELAND IRON MINING COMPANY.—(MAY, 1882).

The history of the Cleveland Mine has been pretty fully chronicled in previous reports. Its career as a mining company has been one of uniform success, and the explorations made with the diamond drill during the past few years have discovered such a vast amount of first-class ore, yet untouched, that the company is nearly assured of a continuance of its prosperity for an indefinite future.

The output of the mines for the past year was 198,569 gross tons, exceeded only by the Republic and the Lake Superior Mines. Its total shipments foot up to 2,327,698. The past year's product was chiefly obtained from what are called No. 3 pit, the Incline pit, and from the Cleveland Hematite. No. 3 lies adjacent to the New York Mine, and commences at the northwest corner of Sec. 11, and runs west 960 feet, 650 feet of which distance to the west is underground. The remainder, to the east, comprises the portion of which the roof fell in several years ago. In this pit, the past year, the main mining has been in the west end, which is about 200 feet below the datum, a point on the surface. Here the opening has been pushed about 100 feet, and an extreme distance north and south of 150 feet, making a surface measure of the deposit worked out in the west end of this pit in the last year of 13,000 square feet. To secure the roof five large pillars have been left, four of which have a horizontal sectional diameter of 25 feet, and one of 18 feet. Further to the east, 150 feet, in this pit, on the north side, two blocks of ground have been stoped out, one 35x20 feet, and the other 30x15 feet. Also along the south side of the pit, connecting with the main westerly extension, a narrow strip of ground 8 or 10 feet wide, and 150 feet long, has been taken out.

In the New York Mine, which is worked down to the line of the Cleveland considerably in advance of No. 3 pit workings, shows a breast of ore 20 feet to 30 feet high all along the south side of the New York openings. Nine diamond drill holes have been made in this pit, mostly to the west and to the southwest, and another has just been started in the direction of A<sup>1</sup> boring. South of the pit five borings have been made from the surface, and the sixth is in progress. The most easterly of these is called B shaft, and is 160 feet distant from the southwest margin of the pit. This boring is 393 feet deep, and passes through 60 feet of No. 1 ore; 130 feet west from B shaft is P boring, 358 feet deep, and intercepts 53 feet of ore in successive deposits, but at 343 feet it had passed through a deposit of 18 feet No. 1 ore. P shaft is 95 feet south from the pit. West from P shaft 100 feet is Q shaft, which is 260 feet deep, and was 9 feet in No. 1 ore when the drill broke, and further progress was stopped. Q shaft is 70 feet south of the mine; 115 feet a little south of west from Q is A<sup>1</sup> shaft, which is 453 feet down, and passes through several deposits of ore, which aggregate 100 feet in thickness. At 421 feet down a single deposit 25½ feet thick of No. 1 ore was intercepted, and of the total deposits found in this hole the No. 1 ore amounts in all to a thickness of

59 feet. Besides the one above mentioned the next thickest seam found in this hole was one of 21 feet thick, at a distance down from the surface of 289 feet. It is in the direction of the lower deposit of ore in this hole that the boring has just been started in the mine. The hole will be, in the distance which it takes, 300 feet long. B<sup>1</sup> shaft, 135 feet to the west, was sunk 381 feet, but no ore was found. At 60 feet distant from it another boring is in progress. These two holes, A<sup>1</sup> and B<sup>1</sup>, were sunk at the same time, in 26 days from the time they were begun.

The Incline pit, lying south of No. 3, has also been greatly pushed during the year. The underground margins of these two pits are 200 feet apart. It is entered, as is No. 3, by inclined skip-roads descending to the west. No. 3 has a double skip road, which starts from the surface 200 feet south from the section corner, and descends into the mine in a direction nearly due west to the limit of the workings. In addition a single skip road starts from about the same place and descends to the south part of the mine called No. 2 pit, making an angle with the double skip of 15°; it bends around to the north after penetrating some distance into the mine. From the main skip road branches extend in various directions as required.

The Incline is a large open pit inclining sharply to the west, and from the bottom of which the underground opening extends to the west upwards of 400 feet, and having a width, north and south, of 250 feet. Four skip roads descend into the mine from the east side of the pit, and the loaded skips, which are drawn up these tracks, discharge their contents into the railroad cars through the ore shutes, erected above, to the tracks.

A year ago the Incline pit was looking remarkably well; one of the finest stopes to be seen anywhere in the iron region was found in this pit. The product of the pit last year was 115,000 tons. At present it shows far less favorably, though still looking reasonably well. From the west end the extent of new opening, is to the west from 50 feet to 90 feet, and to a width, north and south, 200 feet. The surface measurement of this west end opening is 14,000 square feet. Its depth below the surface is 130 feet to 180 feet. Extending east along the north margin of the pit is a belt of new opening 130 feet, north and south, and 20 feet to 25 feet wide. Also on the south side of the pit, in the last year, three considerable blocks of ground have been stoped away. The east one is 40x20 feet; the next 60x35 feet, and the west one of these three having an average length of 35 feet, and a width of 20 feet, and on the north side of the pit 140 feet east of the east end of the openings previously mentioned, a chamber has been made of 40 feet diameter, 126 feet below the surface. Ten borings have been made with the diamond drill in this pit the past year, mostly to the west, to explore the ground, both ahead and downward. The results have frequently been favorable, discovering the existence of other deposits beneath the present workings.

In the saw mill pit the underground workings have been extended to within 25 feet of the main engine house. No large amount of work has been done in this pit, however, in the past year. Three chambers have been opened; one at the southwest extremity of the pit, which is 30x18 feet, and from the north and west sides of this new opening diamond drill borings have been made.

Sixty feet northeast of this opening, another of about equal size has been made, in the corner of which is H shaft, in which 6 feet No. 1 ore was found at a depth of 48 feet; 140 feet to the east of this latter another opening has been worked out, somewhat smaller than either of the other two.



Three hundred feet west of the southwest corner of the Incline pit D shaft passed through  $18\frac{1}{2}$  feet of No. 1 ore, and E shaft, 480 feet west from the northwest corner of the pit, intercepts 20 feet of ore. To the southwest, 1,500 feet from the Incline, commences a series of holes extending east and west 700 feet, and north and south the same distance. These are mostly in the meadow, in the north slope of the hill that runs down to the M. H. & O. Railroad. The most easterly one in which ore was found is L, in which 18 feet of No. 1 ore was struck at a depth of 254 feet; 140 feet southwest of L is K, in which 10 feet No. 1 ore was found, at a depth of 269 feet. West of K 80 feet, is H, which was bored 310 feet deep, but no ore was found. North of this 80 feet is N, 415 feet deep, and  $4\frac{1}{2}$  feet No. 2 ore was found, at a depth of 139 feet below the surface. West from N 80 feet is J, in which at a depth of 357 feet, 52 feet of No. 1 ore was found; 180 feet west of this is I, in which  $38\frac{1}{2}$  feet No. 1 ore was found. The lode is 411 feet deep. In T, 180 feet north of I, 16 feet of No. 1 ore was found. In X, 210 feet west of I, 14 feet of No. 1 ore was found. At a depth of 417 feet the boring is 520 feet deep. G, 230 feet south of I, is 466 feet deep, and 10 feet of No. 2 ore was found. In W, 245 feet west of T, 45 feet of ore was found; the hole is 511 feet deep.

Thirty-one of these borings have been made from the surface, embracing an arc in the northeast part of Sec. 11, within the city of Ishpeming, of a half a mile east and west, and a third of a mile north and south, and in most of these ore has been discovered; in more than half the deposits have a thickness of 10 feet to 60 feet. From the underground pits nearly an equal number of borings have been made with, on an average, encouraging results. The Cleveland management do not wish to grope in the dark. They are endeavoring to determine, in a measure, the extent of their mineral deposits, where and how they lie, and thus be able to mine for them in the most intelligent manner.

Recently, the opening of a new mine has been begun, to the southwest, at K and J. In the former a shaft has been sunk and completed, and they are now mining ore and hoisting from this shaft. The drift in the ore is extending towards J, which latter is sinking, and when the ore is reached a drift will be pushed forward to connect with K. The waste rock is run out on an elevated track over the main line of the M. H. & O., and dumped into the swamp. A side track will soon be built to the shafts.

In this mining work four power drills are used, which are supplied with compressed air from the main engine house.

During the past year old No. 3 engine house has been torn down, and in its stead a solid stone structure erected, supplied with a new pumping engine and machinery, that raises all the water from No. 3 and the Incline Mines. This is found to be a great improvement.

Still further important changes are in process of making. The ground is excavated for an addition to No. 1 engine house, the addition to be equal in dimensions to the main portion of the present structure. In it will be placed the machinery for operating the new mine, compressor, hoisting gear, etc. Also will be built, on the north side of main street, on the corner opposite the office, and on the west side of the cross street, and opposite the No. 1 engine house a large stone building for machine, blacksmith, and carpenter shops, etc. This structure will be 147 feet by 106 feet, and will be fully supplied with the requisite machinery for accomplishing every variety of repairs incidental to the work of a large mine.



No. 10, a mile to the east, near the east line of the company's land, has been abandoned. After several years unsuccessful effort to make it a paying mine it was finally concluded, late in the summer, to permanently discontinue the work. The machinery was removed and the mine allowed to fill with water. The ore obtained in this mine is of an excellent quality, but too much mixed to be satisfactorily or profitably mined.

The Cleveland Hematite Mine, situated in the northwest corner of section 2, one mile north and a half of a mile west from the main mine, has been worked by the company since May 14, 1881, at which time it came into the company's possession, having been opened and previously worked on a lease by Mr. R. Nelson, of Ishpeming. The company shipped from the mine 9,000 tons of ore during the year, and have done a good deal of exploring work. Three shafts were sunk to respective depths of 90 feet, 165 feet, and 190 feet; in the last two good ore was found. The estimated yield of the mine for the ensuing year is between 5,000 and 10,000 tons.

The Cleveland owns 2,200 acres of land in one body, and in all portions of its territory there are indications of ore, and it is not unlikely that valuable deposits of this mineral may be found in other portions of the property than those which have been indicated. The company was incorporated first in March, 1852, and subsequently reincorporated as the Cleveland Iron Mining Company, with principal office in Cleveland.

The officers are: S. G. Mather, President; Jay C. Morse, Agent, Marquette, Michigan; D. H. Bacon, Superintendent, Ishpeming, Mich.

#### THE NEW YORK MINE.—(MAY, 1882).

The New York Mine is situated in the southeast corner Sec. 3, T. 47, R. 27. Its old openings begin near the section corner and extend west along the south line of the property about 1,160 feet, 200 feet west beyond the Cleveland workings. The main lens or deposit of ore is the same as No. 3 pit of the Cleveland, and is 150 feet to 180 feet below the surface. The ore dips to the south and to the west; heretofore it has been almost wholly to the south, passing the line at but a few hundred feet from the outcrop on the surface, and were it not for a curvature to the north, which the formation assumes, not far east from the present workings, the mine would, ere this, have been exhausted. This bend, giving the mine somewhat of a horse shoe shape, has prolonged its existence. The mine, as now worked, occupies but a limited space. There are four pits, and the skip roads descending into them are not far apart. The pits, however, are in different lenses of ore; Nos. 2 and 3 are in the upper deposit of the main mine, adjoining the Cleveland line, and Nos. 4 and 5 are in a deposit underlying the former, about 40 feet below it.

A skip road into No. 3 descends through the open pit to the south, but in approaching the line bends to the north, and now has a direction toward the southwest corner of the property, which is only 190 feet distant from the limit of the workings. No. 2 skip descends into the mine, making an angle of about 70° with No. 3, but below, within the mine, owing to the change in the direction of No. 3 skip, the roads are now nearly parallel. Each of these skip roads follows the foot wall in its descent, but the change in the direction of No. 3 is made of necessity to avoid getting nearer the line. The bottom of No. 2 is about 160 feet from the west line of the property, and the pit is not showing well in that direction; the hanging wall comes down and cuts off

the ore. The opening, however, will be pushed through this wall with the hopes of recovering the vein further on. The prospect is none too encouraging, since a boring made with the diamond drill, west of this, near the line, to a depth of 400 feet, discovered no ore. No. 3 pit is of course all right; it is the main stay of the mine; but, unfortunately, its progress is stayed by its boundary line. Along the line of the property at this point is exposed a wall of ore 30 feet high.

The skip roads in Nos. 4 and 5 pits start from the surface to the north of those in Nos. 2 and 3, and go down in about the same way, No. 4 descending to the south and No. 5 to the west, both following the foot wall of the lower vein. These pits are separated from those above by about 40 feet of chloritic schist. A year ago No. 4 was looking finely; hopes were entertained that it would prove as good as No. 3, in which case the mine would have a long lease of life; but the vein has since greatly narrowed, and, from affording a stope 20 feet high, it is now scarcely one-half that amount, and from giving a product of 15,000 tons, the amount which it afforded last year, the pit will scarcely yield 8,000 tons the ensuing year. No. 4 has been extended to the west to within 150 feet of the line, and, to the south, it seems likely to play out altogether. No. 5 is a sort of scrambling pit, made up a good deal by seams of ore, separated by seams of soapstone; still there are some fine stopes in the pit, in the direction of No. 4.

All the pits are pushed forward together, making each furnish its quota of the product, as far as possible.

If no further discoveries are made the life of the mine will depend somewhat on the dip of the ore; the greater the dip the longer the deposit will continue; but the dip remaining as now, with the present rate of exhaustion the mine cannot continue as a large producer beyond three or four years; but in any event it won't die in debt to its owners. No mine in the district, of its size, has probably made as much money as the New York. It has produced an aggregate of 974,840 tons of ore, all of it first-class ore, which has sold in the market at the highest price and has been very cheaply mined. Subsequent to the war, when ore sold at enormous figures, this mine must have been worked at great profit. The output for 1881 was 50,074 gross tons.

The property comprises only 40 acres of land, owned in fee by Mr. A. R. Harlow, of Marquette, but the mine has, since the organization of the company in 1865, been mainly controlled by Mr. Samuel J. Tilden, of New York. The company have paid Mr. Harlow 25 cents per ton royalty. The lease having recently expired has, it is said, been renewed for an additional period of twelve years. The property ought to be owned, or controlled by the Cleveland Iron Company. It would be very convenient for the Cleveland Company, in working the further extension of their No. 3 pit, to have the New York shafts and openings.

Captain Beering is driving from No. 4 pit, a drift to the north, to explore the ground; and is in now 50 feet, but has not yet reached the limit of the foot wall. In the ore are sometimes found small deposits of bright red banded jasper, inclosed in the best of ore; also occasionally occur limited deposits of "mundie," sulphuret of iron. All such are, of course, thrown out.

The general office of the company is in New York. S. J. Tilden, President; J. H. McCloskey, Agent; August Beering, Mining Captain; John C. Cutter, Cashier, etc., Ishpeming, Mich.

## THE IRON CLIFF COMPANY.—(MAY, 1882).

The Iron Cliff Company has a large landed estate comprising some 38,000 acres of land, which were purchased in 1864 of the St. Mary's Canal Company, and which constitute a portion of the land which that company received from the government for building the original canal at the Sault de St. Marie in 1855. The company was organized in 1864, with a capital stock of \$1,000,000, divided into 40,000 shares of \$25.

W. H. Barnum, President, Lime Rock, Connecticut; A. W. Maitland, General Manager, Negaunee, Mich.

On this immense mineral property the company is working four iron mines, to wit: the Barnum, Salisbury, Foster, and the Section 12 Mine, and in addition the company also owns and operates the Pioneer furnaces at Negaunee.

Of its mines the most important is the Barnum, lying within the corporate limits of the city of Ishpeming, west of the New York and north of the Lake Superior Mines, but lying close to the latter, so that in the underground openings one may pass from one mine into the other. As the deposit of ore, which has heretofore been mined in the Barnum, lies so nearly adjacent to the Lake Superior Iron Company's line, and dips to the south, that portion of it on the Barnum side of the line is rapidly approaching exhaustion. The two most westerly pits are all that remain to be worked, and of these, the east pit will not last beyond the present season, and probably the succeeding year will finish the entire mine on this part of the location. This mine has no compressor; only hand drills are employed. The company realize the value of air drills in pushing and economizing mining work; but the mine is so nearly worked out that it has not been deemed advisable to add any new plant to the old mine, reserving all new machinery and improvements for the new mine.

The mine produced the past year 27,883 tons of ore, and its total product since 1868, the period of its opening, is 487,906 tons. The mine was quite fully described in the last annual report, and is now very similar in its appearance as at that time. Another lift has been sunk, and consequently a nearer approach to its boundary attained. Its loss is its neighbors gain; but the exhaustion of this mine by no means numbers the days of the Barnum. It has a future that is certain to very far surpass the record of its past. Across the intervening swamp, a few hundred feet to the north, a new mine is being opened that will undoubtedly become one of the largest producing mines in the district. The existence of an immense body of ore has been proven by a succession of diamond drill holes, for a distance, east and west, of 2,000 feet, and for several hundred feet north and south mine borings have been made, all of which passed through No. 1 ore, from 20 feet to 50 feet in thickness. The ore, in the holes, was struck at a distance below the surface, of from 350 to 585 feet. The ore occupies a synclinal, and to the bottom of the trough one shaft has been sunk and a second one attempted.

A shaft, the most easterly of the two, has been sunk down through the ore, a total depth of 485 feet. It is a vertical shaft, 10x14 feet inside, and lined up with 12-inch square pine timbers, and is divided into two compartments. From the bottom about 100 feet of drifting have been done in the ore, 50 feet each way from the shaft. The ore bed has a perpendicular thickness of about 30 feet, as shown in this opening, and the product is a very fine grained hard, steady specular ore. In this mine air drills are used, and the new hoisting machinery will soon be ready to work. Some difficulty is already experi-



enced from lack of ventilation, to obviate which a fan has been procured and is now making ready to work. The plan of opening the mine will be by a succession of parallel drifts connected at proper distances by laterals, and as the main drifts will be in the bottom of the fold, the ore deposit will rise to the north and to the south from it. Two east and west drifts, 12x16 feet, have been started, and with proper ventilation there should be no difficulty in mining all the ore that can be hoisted in this single shaft. Already 1,500 tons per month are taken out.

B shaft is 750 feet to the west, and the endeavors to sink it have thus far proved abortive. From the surface to the ledge is 104 feet, but after passing through 36 feet, from the surface down, quicksand is encountered, of a kind very difficult to overcome. It pours into the shaft at the rate of 700 gallons per minute. However it is not the intention of the company to abandon the attempt. Mr. W. H. Barnum, the President of the company, declares that the shaft must go down, cost what it may, and Capt. Sedgwick is again making preparations to again renew the struggle—human ingenuity versus quicksand. The new engine house machinery to operate this new mine is very complete, and will suffice for a long time to come. In exploring, plant, and mine work, etc., on this new location, nearly a quarter of a million of dollars have been expended. The old mine is in the southeast part of the N.  $\frac{1}{2}$  of Sec. 9, T. 47, R. 27, commencing close to the quarter-post corner. The new mine is in the N.  $\frac{1}{2}$  N. W.  $\frac{1}{4}$  Sec. 10.

The Superintendent remains as heretofore, Capt. Wm. Sedgwick.

#### THE SALISBURY.

The Salisbury, the second in importance of the Iron Cliffs Company's mines, has done extremely well the past year, having made an output of 43,690 tons, more than double its product of the preceding year, and the prospect for the coming year is such that it is exceedingly probable that the yield of the mine in 1882 will be in excess of its recent output, if not greater than any annual product it has ever afforded. The mine was opened in 1872, and has thus been worked ten years, during which time it has shipped 239,249 tons. Its greatest product was made in 1878: 52,155 tons.

The ore is a very soft hematite, and is mined from three open pits, and from an underground drift, which has been opened beneath the bottoms of these pits, and which extends east and west as far as the limits of the pits. In this underground drift the principal mining that has been done is in the portion beneath No. 1—the easterly pit. A drift to the south 50 feet, passed through a body of excellent ore upon the development of which considerable hopes are based.

In addition to the three pits described in our last annual report, and to which description there is little to add that will be of interest, the company has opened another pit to the east across the ravine, 1,200 feet distant, and which is thus far proving very valuable. Exploring had been previously done here, but attended with little success until within the past year. Capt. Bortle, in continuing the exploration, hit, fortunately, upon the ore. The ore runs east and west, with a jasper foot wall and a quartzite hanging, and has a width of about 14 feet. The ore is apparently of better quality than that obtained from the old pits; 5,000 tons of it were taken out last year.

The Salisbury is in the N.  $\frac{1}{2}$  of Sec. 15, T. 47, R. 27, and is but a short



distance south of Lake Angeline, being in the south part of the high ridge that separates it from the lake.

Capt. Bortle, the Superintendent, is an energetic, capable mining man, and finds ample exercise for all his experience and capacity in surmounting the many difficulties which are met with in prosecuting work in this mine. He has had four years experience in working in the mines in Nevada, and has familiarized himself with the system of timbering practiced in that country, which knowledge comes into play in the underground workings of the Salisbury.

Below the east, open pit, 70 feet, is an underground level that extends several hundred feet to the east, from which a large proportion of the product is now being raised, through the pumping shaft. The roof of this subterranean level is entirely supported by timbers. These timbers are 9 feet long, placed upright, 4 feet apart, in rows, stayed from the top by cross timbers and blocks. They reach to the roof, and in taking out the "back" these cross timbers are covered with lagging, which forms a floor, and a chamber above is thus taken out to the height of another set of uprights, and the spaces below, in between the timbers, is filled with rock and dirt. The filling in is important, to stay the timbers laterally, to prevent them from knuckling down, which they would be nearly sure to do from the great weight upon them, after several successive tiers had been carried up. If the mine does not furnish debris sufficient for the purpose the material should be taken in from the surface.

#### SECTION TWELVE MINE.

Section 12 Mine, as it is called, consists of open pit workings situated in the northeast corner Sec. 12, in the city of Negaunee. The McComber Mine workings, in the northwest corner Sec. 7, and the Jackson Iron Company's east pit, and the Cliffs Company's northeasterly pit, are close together. The mine has been worked for three years, and has produced an aggregate of 18,600 tons, 13,243 of which were taken out last year. It is doubtful if the output will exceed one-half that amount the coming year. Some further exploration is contemplated to the east, which may lead to the discovery of further deposits between the ground now opened and the east line, otherwise the mine is likely to be ere long exhausted. They are cut off on the east by McComber, and on the north and west by the Jackson Company, and on the south they are limited by the greenstone. Their main cut is crossed by the line, east and west, leaving the northwest part of the main pit to the Jackson Company. The direction of the pit varies about  $10^{\circ}$  from the east and west line, which crosses it, and as the ore lens dips to the north, it has already mainly passed to the Jackson side of the line. However, there is still considerable ore to be got out, but it is now covered by a heavy fall of rock from the Jackson north wall. This debris is now being removed; when cleared a party will go in and mine out the ore to the line. The ore should dip to the south, and it is possible that it may turn, at greater depth, and be again found in the Cliff land. A short distance to the south and east of the main pit is another long, narrow, open cut, 50 feet deep, separated by an arch of ground from the other. In the bottom of this a narrow vein is now working by some scammers. The same party have started a shaft fifty feet south toward the greenstone, and have struck some good hard ore, but come again to broken jasper and ore. They are now stripping to the west and throwing the dirt into

the shaft. In this corner there is considerable space to explore, between the openings and the greenstone, and it may be worth the company's while to prove it. A shaft could be sunk and a drift to the south to the greenstone, and also east and west, or a diamond drill might be employed boring south from the openings across the formation.

#### THE FOSTER.

The Foster was the first mine opened by the Iron Cliffs Company, and was one of the earliest worked hematite mines in the district. It was opened in 1865, and down to 1873 was vigorously worked, since which time its annual output, as will be seen in the table, has been high. The ore is of an excellent quality, but is a good deal mixed. The mine consists of open pits 50 feet to 100 feet in depth; the ore occurring in pockets requires careful sorting. It lies in Secs. 22 and 23, T. 47, R. 27.

In December last work at this mine was renewed by the company with the determination to try and make a success of it.

#### THE LAKE ANGELINE MINE.

The Lake Angeline Mine, belonging to the Pittsburgh and Lake Angeline Company, is situated south of the Lake Superior Mine, about three-fifths of a mile, and directly beneath the high greenstone bluff that rises abruptly near the west end, and on the south side of Lake Angeline. The formation dips to the north, and the ore lenses pitch to the west. The overlying rock is a friable hematite schist, through which the water of the lake does not find its way into the mine; the bottom of the mine lies 150 feet below the surface of the water. The mine, as worked out, consists of two large, open pits, that have now reached to a depth of 160 feet, having a length of 1,000 feet. The east pit has the appearance of being nearly worked out; it has been gradually narrowing, all the sides sloping to the center of the bottom, so that now the workable deposit in the bottom is small. In the west pit the workable ground has diminished, in the bottom, but a leader has led to the taking down of the southwest corner of the pit, discovering a good but narrow vein of ore leading off to the west. It is a matter of surprise that the company has not heretofore explored the ground to the southwest. A small shaft was sunk, situated about 200 feet in that direction from No. 2 pit, and struck good ore, though somewhat mixed; but the shaft was too small to admit of boring extended to sufficient depth as to allow of drifts being run from it to any great extent.

It is the intention to enlarge this shaft and explore this ground. A drift would readily run from No. 2 pit to it.

The officers are: John Outhwaite, President; L. E. Holden, Secretary and Treasurer; A. Kidder, General Agent; Capt. Harvey Diamond, Superintendent.

The shipments for 1881 were 18,060 gross tons, and its total shipments to date are 525,697 gross tons.

#### THE NATIONAL MINING COMPANY.

The National Mining Company holds on a lease from the Lake Superior Company 240 acres of land, embraced in the south part of the E.  $\frac{1}{2}$  of Sec.

16, T. 47, R. 27. The mine was quite fully described in the last annual report, and in visiting the mine this year nothing of additional interest was observed. The last mine, which heretofore was worked in an open pit, is now wholly underground, having reached to the 4th level. The vein is not large and affords, as appears from the stock pits, considerable second-class ore. The product is nearly a hard, blue hematite, but sells for hard ore.

The west mine, 1,200 feet distant from No. 5, so called, is also wholly underground, entered by a single skip, which descends to the north having a length of between 400 and 500 feet. The vein is about 12 feet wide, and the length of the stope now being worked is about 100 feet, somewhat mixed in character. The product is a hard, specular ore. The two mines shipped the last year 24,833 tons, and their aggregate product to date is 91,836 gross tons. About 400 feet to the west of the mine a diamond drill is at work, and is now down 150 feet; is in chloritic schist. The inclination is to the southeast, at an angle of  $45^{\circ}$ .

The mine is under the management of Capt. Samuel Mitchell, Agent of the Saginaw Mining Company, and the local Superintendent is now as heretofore, Capt. Williams.

#### THE MITCHELL MINING COMPANY—(MAY, 1882).

One-half mile south of the National are the Mitchell and the Wintrop Mines, and directly west of them, a half of a mile, is the Lowthian, and adjoining this latter on the west, the New England Mine. All these are soft hematite mines, and very good ones, having large workable depots, but somewhat difficult to mine, owing to the trouble in supporting the roof.

The Mitchell, formerly known as the Shenango, was first opened in 1872, and worked for five years, when a new company was formed, with Capt. Sam. Mitchell as President. The mine now is wholly underground, and worked in two pits, the shafts of which are about 300 feet east and west of each other. The west one is 160 feet deep, and the east one 200 feet. In the west pit they are working a fine lens of ore 30 feet wide.

The east pit is looking equally well. The formation dips to the north and the ore lenses pitch to the west. The ground is cut up so as to leave blocks for pillars, which are lagged up with timbers, otherwise the ore pillars, left to themselves, have little sustaining power. The ore, when mined, becomes friable, and shovels like dirt. The mine is in good condition, and promises well for the future. The product for the ensuing year is estimated at 33,000 tons. In 1881 the amount shipped was 24,146 tons, and the total product to date 75,731 gross tons. The estate comprises 200 acres of land, being the S. E.  $\frac{1}{4}$  of Sec. 21, and the N. W.  $\frac{1}{4}$  N. E.  $\frac{1}{4}$  of Sec. 28, T. 47, R. 27, held on a lease from the Pittsburgh and Lake Angeline Mining Company, who owns the land in fee. Both the C. & N. W. and the M. H. & O. railroads have tracks into this and the other locations on this range.

The present officers are: Capt. Sam. Mitchell, President, Stoneville, Mich.; Chas. Merrywether, Secretary and Treasurer, Ishpeming, Mich.; Capt. James Walter, Superintendent of the mine, Ishpeming, Mich.

#### THE WINTHROP IRON MINING COMPANY.

The Winthrop Mine adjoins the Mitchell on the west. The mine is in the northeast corner of this property. The company hold the S. W.  $\frac{1}{4}$  of Sec. 21,



T. 47, R. 27, and the center of the section, being the northeast corner of the quarter section, is under the engine house, and they have mined close to the line to the south and to the west. In this corner, a few feet south of the engine house, is a very deep, open pit, in the bottom of which nearly all the ore now being raised is obtained. Last October the west end of this pit fell in, burying the bottom to a great depth beneath the earth and rock; in this ruin was also involved the underground openings, which extended west from below the pit. The timbers, upon which the roof mainly rested, were inadequate to support the incumbent weight, and giving way, precipitated the whole west end of the mine; fortunately no one was killed in the catastrophe, though a number of men were temporarily cut off from exit, but were speedily relieved, somewhat frightened, but not otherwise injured.

The removal of all this debris has been a serious matter, involving much labor and expense, and the work is not yet completed. A long skip road has been run up from the bottom, extending to considerable height above the surface to the south of the pit, and up this track the refuse is drawn and dumped from the upper end. A large dump pile has already thus been made and is continually increasing in size. The hoisting rope, which works this skip, has a long run, from the engine house away around the west end of the pit to the south end of the skip road.

West of the engine house about 600 feet the company is now sinking a vertical shaft, which is down to a depth of 200 feet; it will be continued 200 feet further. The shaft is close to the line, and is 13x17 feet inside the timbers, and will suffice for a double skip and pumping shaft. It is precisely what is needed, and is a work that has for some time been contemplated by the company. When the shaft is completed the mine will be opened to the east, and below the old mine, and the ore taken out above. The previous workings to the west, in the direction of the shaft, have shown the existence of an abundance of ore to which the shaft will afford access. The only underground mining doing at the Winthrop at present is in a small pit about 200 feet a little south of west from the new vertical shaft, which runs down on an incline to the north 150 feet. The ore lens does not appear to be large, and the ore is of but medium quality.

Further to the southwest, toward the center of the quarter section, a deposit of fine, hard blue hematite ore was discovered, which opened so promisingly that the company felt about certain of having another mine. A small hoisting and pumping engine was erected, and the Northwestern Railway Company surveyed a line for a track to it, but after taking out about a 1,000 tons of ore, the deposit was worked out. Some further work will be done with the hope of recovering the vein. The ore that has been mined will be hauled with teams to the cars.

Both the Winthrop and the Mitchell Mines make a great deal of water; few mines in the district require a greater amount of pumping. The ravine, which ascends rapidly to the west, is swampy, and furnishes considerable water, which finds its way into the mines. So much water in soft hematite mines is a serious inconvenience, but here there does not seem to be any way of avoiding it; the only alternative is to pump it out.

Besides the quarter section of which the company has the lease, it also controls the surface right to eighty acres adjoining on the north, the two forties cornering at the center. On these most of the houses and surface improvements are built, among which are included a fine, large school-house, and a new Methodist church, etc. The Winthrop produced in 1881 43,630 tons of



ore, and the aggregate product is 256,300 tons. Both the Chicago & Northwestern and the M. H. & O. railroads have branches into the location; about 100 men are employed at present, and a sufficient number of comfortable houses are provided for their accommodation. The location is three miles from Ishpeming, in a southwest direction, and is connected therewith by an excellent wagon road.

The officers are: J. O. St. Clair, President; E. G. St. Clair, Secretary and Treasurer; G. A. St. Clair, Superintendent. Office, Ishpeming, Mich.

#### THE SAGINAW MINE.

The Saginaw Mine has not been very prosperous for the past few years. No. 2 pit is the only one now working to any extent, and that has attained to a depth of 540 feet, but still has a somewhat narrow vein of ore in the bottom. Some borings have been made with the diamond drill, but have discovered nothing of value with the exception of a new "find" on the east line of the west  $\frac{1}{2}$  of the N. E.  $\frac{1}{4}$  of Sec. 20, leased from the Lake Superior Iron Company; here 25 feet of No. 1 ore is said to have been found in one of the holes; 12 feet in another, 140 feet west from the former, and  $9\frac{1}{2}$  feet of ore in a thick hole, 100 feet east from the first one. The distance between the borings make a length of 240 feet, and show a considerable body of ore. The distance to reach it is 85 feet; a shaft is now sinking for this purpose. The mine has been a large producer, and even now, when it is said to be nearly exhausted, it affords a good deal of ore. The output for 1881 was 30,793 tons, and the aggregate product for the ten years since the mine was opened is 420,774 tons. Saginaw is a station on the M. H. & O. railroad between Ishpeming and Clarksburgh.

The property held under a lease by the company consists of the N. W.  $\frac{1}{4}$  of the N. E.  $\frac{1}{4}$  of Sec. 19, and the N. E.  $\frac{1}{4}$  of the N. E.  $\frac{1}{4}$  of Sec. 19, T. 47, R. 27. As heretofore the mine, etc., remains in charge of Capt. Samuel Mitchell, Agent and Superintendent.

#### THE GOODRICH MINE.

The Goodrich Mine is very conservatively managed. In the opinion of some mining men who have examined the location, it might be a larger and more productive mine than it is. A great gain has been made in the two last years, however. The mine has been worked since 1873, and the total output in the eight years is 41,606 gross tons, 21,426 tons of which have been obtained in these two years. The yield is likely to be still further increased the ensuing year. A new shaft has been added 230 feet to the west of No. 2 shaft, and is sunk 100 feet. This new pit is yielding a very good quality of slate ore, which is thought to be first class.

The description of the mine is the W.  $\frac{1}{2}$  of the N. W.  $\frac{1}{4}$  of Sec. 19, T. 47, R. 27. It was first opened by the St. Clair brothers, and is owned by Capt. Goodrich, of Chicago.

The Superintendent is Capt. Henry Davis, who enjoys the reputation of being a very capable mining man.

## THE TEAL LAKE RANGE.

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### THE CAMBRIA MINE.—(MAY, 1882).

The Cambria Mine, worked by the Cambria Iron Company, lies one and a half miles southwest from the city of Negaunee and two and a half miles from Ishpeming. It is connected by rail with the former place.

The land held in lease from the Teal Lake Iron Company comprises the S. E.  $\frac{1}{4}$  of S. E.  $\frac{1}{4}$  Sec. 35, and the west fractional half of Sec. 36, T. 48, R. 27.

The company was organized in 1875 with a capital stock of \$500,000, divided into 20,000 shares.

The mine openings extend about 1,000 feet east and west, and at present the mining is nearly all doing in the two extreme pits, to wit: No. 1 and No. 5. The first named is the most easterly pit, and is worked underground. The length of the skip that goes down on the foot wall to the south at an angle of  $45^{\circ}$ , is 200 feet. It is in about the middle of the pit, and the slope 75 feet each way from it. The vein has here an average width of about 20 feet. The old skip road has been abandoned, and the one now used is new, going up into an ore pocket, also new. No. 2, to the west of the former, is a long, comparatively shallow, open pit, which has been worked in a series of pockets; it is possibly too much in the foot wall, judging from the experience of the company in No. 1, for No. 1 pit had formerly a very similar appearance as No. 2 now has, but pushing further to the south into what seemed to be the hanging wall, developed the ore in body. At present No. 2 is only worked by scrammers. No. 3 is a large open pit that for some reason has not lately been worked. There is too much water and dirt in the bottom to form any judgment of its real character. Mr. Maitland states that he will soon sink a shaft from the bottom near the west end of the pit, and feels confident that he will strike the blue ore found in No. 5, though it may require going to a considerable depth, as No. 5 ore lense pitches to the east and south.

No. 5 pit is the most valuable part of the mine; it is opened to the west line of the property. The east pit of the Bessemer Company and No. 5 are one and the same pit, the north and south line, dividing the properties, crosses the pit, leaving about two-thirds of it to the Cambria and the remainder to the Bessemer. From the line to the west end of the pit is about 100 feet, and the width is about 80 feet, and depth 60 feet. The Cambria have a new skip road going down to the south, to the bottom, and extending up into a new ore pocket that stands over the railroad to discharge into the ore cars.

The whole bottom of the pit is a dark, blue, slaty hematite ore yielding  $66\frac{1}{2}\%$  in metallic iron and  $2\%$  of silica,  $.045\%$  phosphorous, and sells in the market at the same price of hard ore. About one-third of the total product of the

mine is first-class. A drift to the south, from the southeast corner of the pit, 65 feet, was all the way in ore. They are stripping the ground in this direction preparatory to sinking near the end of the drift; also they are sinking in the center of the pit sufficient for a stope to extend over the whole bottom. To the southeast the drift is about 8 to 10 feet thick, where ore is reached, slightly mixed, but is taken to the stock pile. It is the same here as it was in the main pit. For a considerable distance down the ore was variable and mixed, and did not, at first, attain the settled character which it required and preserved after reaching a depth of 20 to 30 feet.

The company has contracted to furnish 35,000 tons of ore the coming season, and will have no trouble in filling the contract. At present the ore is being very cheaply mined. Some new machinery is now being added, consisting of four hoisting drums, 4 feet diameter each, also new engine and boiler. The old machinery was inadequate, and when the new is working the mine will be much better provided with the necessary power.

A half dozen new log dwelling houses have been built down near the lake, and a new change and warehouse has been added also.

The location is upon high ground, overlooking Teal Lake, a very beautiful sheet of water, and has a natural drainage that thus far keeps the mine quite free of water. The company now employ 60 men, under the immediate charge of Capt. Gordon Murray.

The General Manager is Mr. A. W. Maitland, manager of the Iron Cliff Company, Negaunee, Michigan.

The Cambria produced, last year, 19,245 tons, and the total to date is 55,703 tons.

#### THE BESSEMER MINE.

The Bessemer Mine joins the Cambria on the west. The estate comprises 80 acres of land, being the W.  $\frac{1}{2}$  S. E.  $\frac{1}{4}$  Sec 35, and notwithstanding some unfortunate mishaps which the mine has met with of late, it is, on the whole, looking as favorable as ever. The large open pits which formerly constituted the mine, and which have been fully described in the preceding report, have both fallen in from the sides, burying the bottom beneath fifty feet of earth and rock. The last and most serious fall occurred in February, 1882, since which time no ore has been obtained from these pits.

The only alternative is to sink below the ore and resort to underground mining, supporting the roof with timbers. With the view of carrying out this plan, the company is now sinking a shaft between the two pits. The shaft is down 100 feet, and will have to go about 50 feet further to reach the old level.

The new find, mentioned in the last report, has been developed, and proves to be in value everything that it promised. This new pit, as stated in describing the Cambria, is close to the east line, forming one and the same pit with the No. 5 of the Cambria.

The pit is somewhat elongated, with the long axis northeast and southwest, 75 or 80 feet, and with a width of 40 or 50 feet. The west end is worked out to the bottom of the Cambria pit, and they are now stoping in the southwest, and here they have a stope the full width of the vein between 40 and 50 feet in height, with a length of about 50 feet, of the very best quality of ore, 66 to 68 % in metallic iron and very low in silica and phosphorus. It is a loose, dark colored hematite, looking, at a little distance, like rich vegetable mould, and is shoveled with the same ease as ordinary dirt. Just at present, in this

pit, the ore is obtained with little cost. They are now mining here 200 tons per day. A new hoisting engine, boiler, and two 4-foot drums are on the ground and getting ready as rapidly as possible to operate this pit. The hoisting is now done with a derrick and buckets, but a skip road terminating in an ore pocket is constructing and both are nearly completed, when the skip road will be operated with the new hoisting machinery.

The land is owned by the Teal Lake Iron Co., and is held on a lease by the Bessemer Iron Co., in which Mr. C. M. Wheeler, of Marquette, is largely interested, and who is also Manager of the mine.

The last year's product was 16,718 tons, and the aggregate to date is 87,023 gross tons.

Adjacent to the Bessemer on the west, between it and the Forest City Mine, is a tract of thirty acres, which has been leased by Mr. D. F. Wadsworth of Ishpeming. This gentleman has a party of men now at work on the property, exploring for ore, with thus far favorable indications.

#### THE FOREST CITY MINE.

This mine, lying next on the west, is now substantially idle. The mine openings, as described in the last year's report, are close to the line of the Cleveland Iron Company's land, on the south, and as the ore deposits dipped in that direction, it soon pressed beyond the limit of the property. No other workable deposit having been discovered, the mine was shut down.

The only thing doing is by a small party of men exploring to the east of the former workings with a churn drill, with as yet no very favorable results. The property, comprising 60 acres, is held on a lease by the Forest City Iron Co., the officers of which are residents of Cleveland, Ohio. F. A. Bates, Secretary.

The shipment in 1881 was 1,895 tons.

#### CLEVELAND HEMATITE.

Adjoining the Forest City is the Cleveland Hematite, which is described with the Cleveland Company's mine.

#### THE NORWICH.

Cornering on the Cleveland and Forest City, to wit.: the N. E.  $\frac{1}{4}$  N. E.  $\frac{1}{4}$  Sec 3, T. 47, R. 27, is the Norwich, a new undertaking which promises to be a mine of some value. A shaft has been sunk on the south side of the highway, not far from the northeast corner of the forty, which is down 38 feet. From the bottom of the shaft a drift has been made to the south 67 feet, on a narrow cross course of soft ore. North of the road, 145 feet west of their boundary line, a shaft has been sunk 25 feet, and from the bottom of it is a drift leading 30 feet to the north, all in ore, with ore still in the end of the drift. The ore is a yellowish, soft hematite, similar to that of the Cleveland. The location of the shaft is in a cedar swamp, and they are likely to find much trouble with water.

The local Superintendent is Capt. Frank Treblecock.



## THE NORTH RANGE.

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Within the past few years a good deal of exploring has been done on what is called the North Range, resulting in the discovery of several important mines, among which are the Boston, Sterling, Dalliba, Northampton, Jim Pascoe, Marine, Webster, etc.

### THE BOSTON.

This range of mines lies north of the M. H. & O. Railroad, and the mines above mentioned, and in some respects the most important, is the Boston, situated about two miles north of the village of Clarksburgh, a station on the Marquette, Houghton, and Ontonagon Railroad. The Boston Mine Company was organized in the latter part of the year 1879, by some Marquette gentlemen who had purchased of the railroad company the eighty-acre tract on which the ore had been discovered, and where the mine was immediately opened and has since been worked. The land comprises the S. E.  $\frac{1}{4}$  of the S. W.  $\frac{1}{4}$ , and the S. W.  $\frac{1}{4}$  of the S. E.  $\frac{1}{4}$  of Sec. 32, T. 48, N. R. 28.

The mine proper has a length of about 400 feet and a depth of 140 feet. It is really an open pit, but floors have been made by placing cross stulls from foot to hanging, and lagging them over, leaving openings for the hoisting bucket. The strike of the vein is N.  $75^{\circ}$  W., and the dip is, with almost perfect regularity,  $80^{\circ}$  to the south. The hanging wall is a firm gray quartzite, and the foot a banded jasper. The rocks here are found to be identical with those at the Champion and at other leading hard ore mines of the Marquette iron district. The mine is situated upon an elevation of land close to the west line of the property, and the mine is opened through into the Sterling, which joins it on the west.

This high ground is of limited extent, the remainder of the company's land being a level plain, terminating in a small lake, Lake Boston, in the southeast corner.

The owners have undertaken to determine the extent of their ore deposit, in some degree, during the past year, and the result has proven very satisfactory to their interests. These explorations have been made with a diamond drill; four borings have been made across the formation, and cutting through the ore vein, several hundred feet below the surface. They have thus proved the vein for a distance east and west, of 1,140 feet.

No. 1, the west hole, is 300 feet east of the line, and cut the vein at 225 feet below the surface, passing through a width of No. 1 ore  $10\frac{1}{2}$  feet, measured at right angles with the walls, and subsequently perforating a

hematite belt 12 feet in thickness, of good ore. An analysis of the ore of the former gave, metallic iron, 67.12; silica, 1.62; phosphorus, .006. Analysis of the hematite gave, iron, 59; phosphorus, a trace only.

Three hundred feet to the east No. 2 drill hole was bored, passing directly beneath what is called the wet shaft. This shaft was sunk soon after the organization of the company, and has, until recently, been used to furnish the water for the boilers and for the use of the location. In No. 2 was found, at a depth of 189 feet,  $13\frac{1}{2}$  feet of specular ore, and the drill subsequently penetrated, after passing through a belt of jasper, 27 feet of hematite ore.

No. 3 hole is 500 feet east of No. 2, and at a depth of 192 feet, vertical, a thickness of  $13\frac{1}{2}$  feet of hard ore was found.

From the west line to No. 3 hole is 1,140 feet, and it is thus reasonably certain that the company has a continuous run of ore the entire distance. The value of the Boston rests upon the fact of the great regularity and steepness of the vein, and the almost phenomenal richness and purity of the ore. An average of five analyses, made by different chemists, at different times, and from average samples collected by different persons, gives, metallic iron, 67.79; phosphorus, .018; silica, 1.27.

Each of the analyses gave above 67 % in metallic iron, and all but one as low as the average above given, in phosphorus. Other analyses since made, of the drill cores, gave, phosphorus, .006, and equally high in metallic iron. These analyses show, and the working of the ore has practically proven that the ore is valuable for Bessemer steel pig iron. It is sure to be in demand however dull the times may be. As some one remarked, it is a good "panicky" ore, finding a market even in time of panic. Added to this the company owns the fee simple of the land, and thus has no royalty to pay, and otherwise is not restricted. A branch from the M. H. & O. Railroad connects the mine with the main line. The shipment from the mine in 1881 was 14,824 gross tons, and will probably be increased to 20,000 tons for 1882. The total to the close of the year is 21,302 tons. The mine is provided with hoisting and pumping engine, and four 4 feet winding drums; also with a suitable number of dwelling houses and other buildings.

Mr. Fred. A. Wright, the Agent of the Boston, is a new comer in the iron region, but is a very competent, genial gentleman, and is devoting his energy and excellent business qualities to bringing the affairs of the company and the mine into the shape they are entitled to assume. Two changes have been made in the local management within the year, resulting in leaving Capt. P. T. Tracy as Captain of the mine. Sixty to 80 men are employed.

The Jasper shaft, described in the statistical report for 1880 as 387 feet east of the boundary line, was sunk 80 feet and then discontinued, has recently been sunk to 140 feet, intersecting an 8-foot vein of hard ore,  $5\frac{1}{2}$  feet of which is first-class specular slate ore. This new find is widening, and is no doubt a continuation of the same lens upon which they are now mining in the main workings, 75 feet to the west.

The method of mining now pursued is to sink No. 2 shaft and the jasper, continuously, and to stope each way from those shafts. No. 2 is 131 feet east from the west line. They will thus always have stopes to work. The sinking and stoping will go on simultaneously. Among the notable improvements are an ore pocket over the railroad track, and an elevated water tank, ingeniously contrived to wash the ore.

## THE STERLING MINE.

The Sterling Mine lies adjacent to the Boston on the west. The land is owned by Prof. R. Pumpelly and Major T. B. Brooks, from whom it is leased by the company, and comprises the W.  $\frac{1}{2}$  of the S. W.  $\frac{1}{4}$  Sec. 32, T. 48, R. 28. The character of the ore is the same as that of the Boston, and the two mines, which are contiguous, are entirely similar, except that the Boston is the larger opening. At the east end of the Sterling pit, next to the Boston, the ore in the bottom has a width of 12 feet. The mine, as now worked, is a small one; the hoisting is all done in a single bucket shaft, and the product of the mine for the last year was only 4,702 tons; but some explorations have been made to the west in the vein, with a diamond drill, which resulted in developments that greatly enhance the value of the property. No. 1 drill hole, 490 feet to the west, was bored on an angle of  $66^{\circ}$  with the horizon. Its location is in the swamp, and 57 feet of stand pipe was first sunk, from below which the drill passed 145 feet of quartzite, and then penetrated 5 feet 9 inches of No. 1 ore, and then after penetrating 18 feet of jasper and soapstone, 16 feet 10 inches of ore were struck, measured on the line of the hole, and 15 feet of hematite. No. 2 drill hole was located 500 feet still further west, and was bored on an angle of  $58^{\circ}$ . Here 88 feet of stand pipe was first sunk through the drift to the ledge, and the drill penetrated first, 15 feet of quartzite, then 5 feet 9 inches No. 1 ore; then 30 feet of jasper, then 8 feet 3 inches of No. 1 ore, after which only mixed ore and jasper was found.

These borings substantially prove the vein for a distance of 1,000 feet, showing the existence of possibly two lenses of ore.

Analyses of the Sterling ore, from the stock pile and of the drill cases, show it to be of the same uniform high value as that indicated in the Boston, being very high in metallic iron and low in phosphorus and silica. In the mine a drift was run to the north, in the foot wall, 36 feet, which crossed 2 feet only of ore. A drawback to sinking shafts to the west to mine the ore discovered by the diamond drill arises from the wet character of the ground and the depth of the drift; difficulties, however, which can be met and overcome.

A change in the management has resulted in putting Mr. G. W. Reed in charge of the mine, as Agent, and making J. R. Reed Mining Captain.

## THE JIM PASCOE IRON MINING COMPANY.—(JUNE, 1882).

This Company was organized in the fall of 1881. No recent discovery in the Marquette iron region has attracted so much attention as this still celebrated "find." It certainly gives promise of becoming a very large producer of medium quality hematite ore, averaging 60 % in metallic, 2 % silica, and 0.18 % phosphorus. The samples were taken along the vein the length of the property.

The mine is on the north side of the bluff, north of the Dalliba about half a mile, and has been pretty thoroughly explored so far as can be determined by test pits, etc. These extend east and west the length of the property, and by pits and cuts the width of the ore is shown to be, from the hanging slate wall to the jasper foot, 30 feet, and perhaps upwards. At the time of my visit they were working only one pit near the west line, where they have stripped the ledge, east and west, for a length of 200 feet, and have sunk below the top, for a stope, a lift, of 40 feet. The men are now stopping down the east and



west ends of the sink, which is 40 feet high and 30 feet wide. The skip road goes down from the north side, and a small engine to the north furnishes the present power for hoisting. About 100 tons daily are taken out, with very little cost, scarcely more expense than to mine a clay bank.

Other pits have been started further to the east. At all these points considerable preliminary work has been done. The machinery has been contracted for, two boilers, two engines, 12x13 inches, with hoisting gear, including 4 30-inch drums. It will be some time before the railroad is completed in to the mine. The line has been surveyed, and the road is building.

No skip roads have been made; the only one in use is a temporary affair in the pit, which is now working; possibly the matter is dropped, waiting for the railroad company to fix finally the line of the track, etc. The mine will possess great advantage in the matter of drainage, since the descent to the north is a hundred feet or more to the bottom of the valley, which in itself descends to the west to the level of Lake Michigamme.

About 30 men are working for the company under the supervision of Capt. John Foley.

#### THE MESNARD MINE.

East of the Pascoe and joining it is the Mesnard Mine, a still more recent opening, on what appears to be the same vein. The property is the N. W.  $\frac{1}{4}$  of N. W.  $\frac{1}{4}$  Sec. 28, T. 48, R. 29. The showing so far is remarkably good, affording every indication of having a large deposit of ore. They have explored it with test pits, and are now sinking a shaft for regular mining. The shaft is down 50 feet. The property is held on a lease from the Atlantic Mining Company.

The officers are: A. M. Byers, President, Pittsburg, Pa.; W. H. McCurdy, Vice President; J. H. Outhwaite, Secretary and Treasurer.

#### THE DALLIBA IRON MINING COMPANY.—(JUNE, 1882).

The Dalliba Iron Mining Company owns the S.  $\frac{1}{2}$  of the N. W.  $\frac{1}{4}$  and N.  $\frac{1}{2}$  of the S. W.  $\frac{1}{4}$  of Sec. 29, R. 29, T. 48. The mine is directly west of Champion, and at a considerable elevation above the depot at that station, probably 150 feet. Active mining work was begun early in 1881, and the result was the shipment during the season of 10,986 tons of ore. This product has been taken from a pit 160 feet long, east and west, by about 75 feet across. The ground rises to the north and to the south, making a wide, shallow ravine, sloping down to the west toward Lake Michigamme. The strike of the formation is in this direction, and the dip is to the north.

The main pit has been worked to the depth of about 50 feet. The north wall is a face of rock beneath which the ore seems to extend to the north. It is thought that the work is against the foot wall, and that the body of the ore is still to the north. To the east of the pit the earth has been removed for upward of a 100 feet, and at 87 feet from the pit, east, a shaft was sunk 25 feet, striking the foot wall; from the bottom of this shaft a drift to the north 17 feet came into the ore, what is believed to be the true lens. An ore pocket has been built and a skip road extended down to this point of the mine, which will soon be in readiness for hoisting ore. Two skip roads go down into the main pit, conveying the product up into substantial ore pockets above the railroad tracks. They are now hoisting about 140 tons per day, which amount



it is expected to more than double as soon as the other pits are ready to produce, and they have enlarged the productive capacity of the present working pit.

About 100 feet to the west beyond this main pit they are stripping for another pit; it is a harder ore and apparently another lens. The M. H. & O. Railroad have a branch running along the south side of the mine openings. The engine house and hoisting, etc., are located to the south 200 feet, and the working shafts are operated from thence with wire ropes.

Over on the north side of the bluff, which separates them, the company has made extensive explorations, upon the westerly extension of the Jim Pascoe deposit. Everything is in readiness to open a new mine here as soon as the railroad is built to the location. The product of these mines is mostly a hard hematite. Much of it of a bright ocher, and a light or dark umber color. It is not adapted to the manufacture of Bessemer steel, and requires picking over: The company is working about 100 men, and Capt. Pascoe declares that if they can have the cars they will ship 50,000 tons of ore the present season.

The officers are: James H. Dalliba, President, Cleveland, O.; W. S. Pollock, Treasurer; Walter Fitch, Agent; John Foley, Superintendent.

#### THE NORTHAMPTON MINE.

The Northampton Mine is about one-half or three-fourths of a mile west from the south Dalliba. It is owned by the Champion Iron Company, and the estate comprises the S. E.  $\frac{1}{4}$  of Sec. 30, R. 29, T. 48, in about the center of which quarter section the mine is situated. North of the old mine the company has just begun the work of opening another mine, designated as the West Northampton.

The workings at the old mine consist of two open pits, the east one of which is idle. The other, a little to the west, is a long narrow pit extending east and west, with sides nearly vertical, 40 feet deep. The skip road comes down to the bottom from the west end and terminates at the top in an ore pocket above the railroad track. At the time of my visit nine men were working in this pit, stoping at the east end and tramping to the skip. The stope at this east end is about 30 feet high and 10 feet or 12 feet wide. The bottom is also of ore. An engine house, 50 feet away, contains the machinery for operating the shaft, etc.

The north pit, now opening, is 400 feet to the northwest. The opening is in the hollow, and the new skip road runs up the side hill to the south, at an increased angle, so that it attains sufficient elevation at the top for an ore pocket above the railroad, which will come in beneath. They have uncovered the ledge 100 feet in length and to a width of 30 feet. This ledge shows some excellent hard ore, hard hematite, very different from that found in the other pits, but is much mixed with rock; in fact I am not sure but the ledge is mostly rock, with some good ore mixed with it. The hanging wall in this, as in the others of these mines, is a black slate, dipping here at a sharp angle to the north. They are sinking at the foot of the shaft and breaking down the ledge to the west, apparently sorting out and covering the ore. The shipping is over the branch of the M. H. & O. Railroad. The management is the same as that of the Champion Mine.

ANNUAL REPORT OF THE  
THE MARINE IRON MINING COMPANY.

The Marine Iron Mining Company is a still newer organization, formed to work the property lying next west from the Northampton. A skip road has been built, an engine house, supplied with two internal friction drums, and engine, etc., supplied by the Marquette Iron Bay Foundry works. The skip road is double; also the ore pocket, and an elevated track, 300 feet in length, extends to the northwest for a rock dump. The location is upon the hillside, northeast from Lake Michigamme, from which it is distant about one-half of a mile. Still nearer is the main track of the M. H. & O. Railroad. Several other buildings besides the engine house have been constructed, ready for occupancy.

As in the case at the Northampton, the skip road extends up the hillside at an angle greater than the slope, giving room for the cars below the ore pockets; but here the skip goes up to the north. At the foot of the skip track they are sinking a shaft, and are now down 20 feet. The drift has been removed from an area of 100 feet square, and some test pits made; one of a depth of 30 feet or more, to the south of where they are sinking, that shows more ore than is to be seen where the work is going on.

In the shaft they are digging up the bottom, which is a loose ledge and very wet; in this is a narrow vein of dark colored, soft hematite ore, which is removed by itself and saved. The rest is discarded. As in the others the hanging wall is a dark slate, but where the foot wall is, is not apparent; it is probably at considerable distance to the south. A large force of men is working, grading the railroad, which will extend through this and the Northampton, etc.

On this same range, eight or ten miles to the west, are several mines or explored properties, which bid fair to develop into mines that shall rival in importance any of those to the east of the lake, in the range, which we have just described.

THE FARM.

The most easterly of these new "finds," situated in the North Range west of Lake Michigamme, is The Farm, so called, though it is not, as yet, an organized company, but is controlled by Mr. Ed. Wetmore, of Marquette, who has conducted the explorations, and who holds the lease. The land comprises the N. W.  $\frac{1}{4}$  of Sec. 25, T. 48, R. 31. It is about a mile southeast of the Spurr Mine, and three-fourths of a mile from Michigamme. The land has been cleared of trees and brush. The surface rises to a moderate elevation, making a ridge east and west through the center of the property, from which the land slopes to the north end and to the south. The exploration pits are made in this south slope. A few hundred feet to the south of the ore, as thus defined, the ground drops down suddenly a height of 50 feet to the level of the land below, through which rapidly runs the Spurr Mountain Creek, having a fall, on the property, of 20 feet, sufficient for a water power to compress air for working power drills, hoisting, etc.

The first pits are about 800 feet west from the east line; there are two of them, 25 feet deep, 30 feet apart, north and south. It is impossible to see the ledge, but the piles by the side of the pits show good ore, yellow, ochreous, light brown, and dark colored ores, occasionally with crystals of carbonate of iron, spathic ore.

Three hundred feet further west are two more pits, showing ore of the same character—yellow, friable, and hard, brown hematite, much of it showing a large amount of lime, but unmixed with rock, and no quartz.

To the west 500 feet further a series of pits are dug across the formation at a distance apart of about 20 feet. The length of this line of pits is 230 feet, and they seem to be all grounded in ore, judging from the material thrown out. It is claimed that the pits were dug as deep as could be done without blasting. It is also stated that the north pit is just at the foot wall, and the south one against the hanging, making the ore deposit 200 to 220 feet wide.

The south pit was sunk, it is said, 40 feet to the rock, and a drift 35 feet to the north made, on the ledge to determine the line of the ore and the hanging wall. In the southerly pits is found some fine, hard ore specimens that will analyze 65 % to 67 % metallic iron. Large pieces are found showing the hard, red, yellow, and brown ores mixed together or occurring side by side. One hundred feet further west is another large pit in good ore, and still to the west 100 feet are others close to the hanging, showing the same ore.

In all this line of pits extends 1,700 feet or 1,800 feet east and west, and near the west end of the explorations is a second line of pits 220 feet clear across the deposit. In this line is the deepest pit, 53 feet, 33 feet in the ore.

Altogether it is a remarkable showing, and would be much more satisfactory if some of the pits had been sunk with powder until the solid ledge were reached, and it had been found to be equally as good as now appears from the looser material already obtained. The strike of the formation is east and west, and the dip is to the south at an angle of about 45°. The foot wall is a narrow quartz bed on slate.

Several analyses have been made, showing the ore to be, uniformly, about 60 % in metallic iron, 2.28 % silica, and .25 % phosphorus, and 10 % water; the percentage of lime has not been determined. The percentage of phosphorous is found to diminish toward the hanging wall, and to be greatest near the foot.

The ground is admirably situated for economical working and drainage. The 50 feet drop from south of the mine to the lower ground where the railroad will come in, affords a fine opportunity for rock dumps and for ore pockets.

The mine has not yet been stocked, owing to the fact that a law suit is pending regarding some rival claims to the lease. As soon as this matter is settled it is expected to effect an organization. It is but reasonable to assume that it will be, for a time at least, a large producing mine.

#### THE WEBSTER MINE.

Still further to the west in this range, and showing ores identical with those found at the Farm, is the Webster Mine, the property of the Webster Iron Mining Company. The company's estate consists of the N.  $\frac{1}{2}$  of the N. E.  $\frac{1}{4}$  and the S. E.  $\frac{1}{2}$  of the N. E.  $\frac{1}{4}$ , Sec. 26, T. 48, R. 31.

The company was lately organized. The officers are: Dr. G. J. Northrop, President; E. B. Palmer, Secretary and Treasurer; A. H. McConnell, Superintendent. The land is held by the company on a lease.

The mining work, recently begun, is in about the center of the eighty, and as the trend is east and west the company has a half mile in length of the ore deposit. The dip is to the south about 70°. On the location they have sunk



on the vein, across it 75 feet, all in ore. The foot wall is a black slate, and the hanging a quartzite, though the hanging wall has not been reached in the test pits. A shaft, 50 feet in depth, has been sunk, all in ore, below the stripping. Two large pits are started, east and west of each other, about 300 feet apart. In these the earth has been removed to the ledge, to a width of 125 feet, and a length west and south of 150 feet. Shafts will be sunk in the center of each of these pits, and a level stoped away, and the ground between the pits also stripped to the ledge, and are stoped to the first level, thus making a pit 500 feet long and the full width of the vein, whatever that may prove to be—75 feet and upwards.

A railroad line is being surveyed to the location, and will be speedily followed by the construction of the road. Some buildings have been erected and machinery secured, which will be got ready to work as soon as may be.

The ore is a yellow, ocherous, and a hard, brown hematite, very similar, if not identical, with that of the Dalliba. The company's land is well covered with a fine growth of timber, and the mine is opening in high, dry ground, giving excellent drainage. It is certainly a very promising mine.

On the N.  $\frac{1}{2}$  of the N. W.  $\frac{1}{4}$  of Sec. 26, T. 48, R. 31, some explorations have been made by means of test pits, which, as in the locations previously described, have thus far resulted very favorably. The pits are bottomed in ore, and have been dug across the vein, showing it to have a great width. This property is held by Mr. Wetmore and Dr. Northrop on a lease.

#### PORTLAND.

Still west, in the S. E.  $\frac{1}{4}$  of the S. E.  $\frac{1}{4}$  of Sec. 22, T. 48, R. 31, they have a line of pits extending from foot wall to hanging, 80 feet. Of course, as the work has been done some time ago, the pits are, partially, now filled with water, so that it is impossible to see the ledge, and one can only judge from the materials thrown out and the statements that are made. These all show very nearly the same character of ore, an ocherous, yellow, or hard, light and dark brown hematite, very free from rock quartz or other rock. This find is called the Portland.

#### THE BEAUFORT.

The Beaufort, so called, comprises the N.  $\frac{1}{2}$  of the N. W.  $\frac{1}{4}$  of the same section 22, T. 48, R. 31. Here about the same amount of exploration has been made, with about the same result as the preceding.

#### THE TITAN.

The same may be said of the Titan, which comprises Lot 1 in Sec. 21, T. 48, R. 31, which has also been explored with the same encouraging indications.



## THE CASCADE RANGE—(JUNE, 1882).

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The occurrence of iron ore in this locality was one of the earliest known in the region. The United States Surveyor, in 1845, observed and commented upon the remarkable outcrop of lean iron ore, upon the top of which is the corner of Secs. 29, 30, 31, 32, and which, forming a high, exposed ledge of lean flag ore and jasper, extends for a considerable distance east and west.

In this rocky bluff considerable mining has been done. Owners of lands and lessees have organized companies and prosecuted work, but the so called ore which they have mined and shipped has generally proved to be suitable for other purposes than iron making.

After the panic in 1873, the mines on this range, with the exception of what was known as the West End Mine, became idle. Subsequently the Palmer Iron Company was organized, and the Palmer Mine. The West End has been continuously operated by that company, and has become so favorably known that it has, to a great extent, redeemed the bad reputation which the ores of this range had previously acquired.

### THE PITTSBURG AND LAKE SUPERIOR IRON COMPANY.

The Palmer Iron Company was merged into the Pittsburg and Lake Superior Iron Company, with Ralph Bagley, of Pittsburg, President; Jeffrey Lippincott, Secretary and Treasurer; Joseph Kirkpatrick, Agent, Palmer, Michigan.

The estate consists of 26,444 acres of land, on which are a number of old mining locations, so that Palmer is quite a village, having a good many houses, generally well built, stores, etc.

At the mine the ore deposit extends nearly north and south and dips at an angle of about  $55^{\circ}$  to the east. Further to the east the formation bends, taking an east and west direction. The mine was at first worked openly, and now shows a series of pits, 640 feet in depth, down the west walls of which the skip roads descend, extending below the bottom into the underground workings. The foot wall is a diorite schist; the hanging, a hard jasper.

Commencing with No. 1 the skip road is down 340 feet; the bottom of the pit is about 85 feet long, separated into two lenses, between which about 25 feet of jasper intervenes. The bottom vein averages 20 feet wide, and the upper one 16 feet. They are wide in the middle and narrow at the ends. The stopes are the full height of the lift, 40 or 50 feet. At both ends are headings of jasper. The skip road goes down on the foot wall vein, and they mine the upper one by milling the rock through a winze into the lower drift. The yield of the pit is 60 tons daily. The several pits are in lenses of ore which underlie each other in succession as we go south.

No. 2 underlies No. 1 to the west 70 feet. The intervening rock is a hard jasper. The skip road goes down from the top 300 feet. The lens is small,

only about 6 feet wide and 60 feet long; the ore is good and the lens just about holds its own as they go down.

No. 3 is in still another lens underlying No. 2 to the west. The shaft is 300 feet from No. 2 and the soap rock, separating the lenses, is about 24 feet thick. The lens of ore is about  $6\frac{1}{2}$  feet wide. They have recently sunk the last level, and are now drifting from the shaft; have opened 30 feet in this level. The pit in the levels above is about 70 feet long.

No. 4 shaft is down 260 feet to the bottom level, which is opened 100 feet. The vein varies in width from 3 feet to 9 feet, and still underlies to the west No. 3, with an intervening wall of jasper of 10 or 12 feet. The whole length of the openings is about 700 feet, north and south, and the daily product is, on the average, at present, about 100 tons. The company has done some exploring with a Bullock diamond drill within the past year. In all five borings have been made.

No. 1 hole was bored at an angle of  $60\frac{1}{2}^{\circ}$  with the horizon, and after going through 115 feet of diorite, was stopped.

No. 2 was bored 50 feet in quartzite, 20 feet in lean ore, 6 feet No. 2 ore, and 20 feet banded jasper. These holes are east from the mine to Sec. 31.

No. 3 passed through 50 feet quartzite, 17 feet No. 1 ore, 28 feet jasper, and stopped; the hole is in Sec. 29, not far from the mine.

No. 4 hole was in quartzite 32 feet; No. 1 ore, 4 feet; barren jasper, 31 feet; vertical hole.

No. 5 is in 505 feet quartzite, bored vertically, and will be continued until they strike the ore. This hole is further to the east, near the location, or the old Cascade Mine. A new pit has been started in No. 5 to the south; have taken off 20 feet of stripping, and have just come to No. 1 ore, 6 feet wide. They are obliged to hoist a good deal of rock. Taking the average of all the pits 50 % of the rock hoisted is thrown away; but from No. 1 very little waste rock, comparatively, is hoisted; from the others it is nearly two-thirds waste, coming mainly from the hanging wall. The company employs about 175 men.

Below the mine and the village the company has in active operation a saw mill and a good stock of logs, and are cutting ore and selling a considerable amount of lumber.

Among the most notable of the improvements which have been made in the past year, is the construction of a fine brick residence for the agent, Mr. Kirkpatrick. It is one of the most substantial, commodious dwellings in the region.

Capt. W. H. Whiteside, upon whom devolves the care of the mining work, etc., has held his position for nine years, and is a competent, estimable man, who has the confidence of the company and of the employés.

The product in 1881 was 39,276 gross tons, and the total output to date is 214,216 gross tons.

Some exploring is being done in one or two of the old mines between the Pittsburg and Lake Superior, and the Wheat Mine, the East End Mine, but nothing of importance has yet transpired.

#### THE WHEAT.

The Wheat is the first active mine to the east. The estate is the S. E.  $\frac{1}{4}$  of Sec. 29, T. 47, R. 26, and joins the Pittsburg and Lake Superior Company's land on the east. It is owned by Dr. Wick, of Cleveland, Ohio, and is held

on a lease by The Wheat Iron Mining Company. While the mine has been worked to a slight extent for some years, the main part of the work has been done in the last year; the openings are not very expensive. The lenses of ore in this range seem, so far, to be small or lean.

At present not much is doing in the mine. They are working in the north end at the bottom of the east open pit, pushing a drift to the north; the drift is in 15 feet in ore; the width is 15 feet to 25 feet, apparently, the lens pitching down to the northwest. The same lens has been followed from the surface, the working of it out thus far making an open pit 100 feet long, 60 feet wide, and 50 feet deep. At the lower end it had been seemingly cut off, but it proves to be only a lens of rock, and the ore is making fully as large beyond and below. The work in the other pits, just now, is only scrambling. The machinery consists of hoisting engine, four drums, pumps, etc. About 25 men are at work under Captain Thomas Trout, and are putting out a weekly product of 100 tons. The company shipped last year 90,000 tons, and has made a total output of 16,444 gross tons.

At the hematite deposit, which is claimed as good ore, nothing has been done.

The officers are: Daniel McGarry, President, Cleveland, Ohio; Thomas Axworthy, Secretary and Treasurer; F. W. Judd, General Agent.

#### THE WICK MINE.

The same parties operating the Wheat own also the Wick Mine, which lies to the south of the Wheat a short distance, being 40 acres in Sec. 32. The officers are the same as those of the Wheat Mine.

The mine is a soft hematite of fair quality, into which a shaft has been sunk 16 feet in ore. Some test pitting has been done, and the shaft is located in the best showing. The work here is in charge of Capt. John Brown.

#### THE CLANCY MINE.

Joining the Wheat on the east is the Clancy Mine, comprising 40 acres of land in Sec. 28. There is nothing to show but some test pits, giving indications of soft hematite ore.

The officers are: John Clancy, President; M. W. Bates, Secretary; I. N. Watson, Treasurer, all of Grand Rapids, Mich.

#### THE GRAND RAPIDS MINE.

Still further to the east is the Grand Rapids Mine, comprising 40 acres, being the S. W.  $\frac{1}{4}$  of the S. W.  $\frac{1}{4}$  of Sec. 28, T. 47, R. 26.

This property was formerly included in what was known as the Gribbon Mine. Some mining work was done last year, and a small stock pile of ore, about 2,000 tons, got out, but the quality of ore is hardly up to a standard that will give it much market value. The pit from which this ore was obtained is not now working.

The work has been transferred to the low ground south of the hillside into which the former pit was made. In this low ground they are sinking in a deposit of tolerably hard hematite, which may turn out to be of some value, but they are hindered in the work by the water. There are a half dozen good log houses on the location.

The officers are: I. J. Whitefield, President; Marcus W. Bates, Secretary; Isaac Phelps, Treasurer; office, Grand Rapids, Mich.

The property is held on an option from H. M. Atchinson, of Negaunee, Mich. The work is in charge of Frank Koop.

#### THE LAXEY MINE.

Joining the Grand Rapids Mine on the east is the LaxeY Mine, worked by a company of the same name, recently organized. The land is held on a lease from H. M. Atchinson, and the officers are well-known Negaunee gentlemen.

J. Q. Adams, President; P. B. Kirkwood, Secretary and Treasurer; H. M. Atchinson, General Manager.

A shaft has been sunk 60 feet in depth, 37 feet of which is claimed to be in ore. They have drifted 30 feet in the direction supposed to be across the deposit; but they have 8 or 10 feet in width of clean ore, and a known length of 40 or 50 feet, and a greater width of mixed ore. They are now sinking to ascertain the depth, and are still in ore. The product is a good quality of hematite. The company has had analyses made, which if the samples were a fair average, make an excellent showing—64.70 % metallic iron; .023 % phosphorus. If the outlook is sufficient to warrant, the branch railroad will be extended to these mines. The hanging wall is a quartzite—the foot a soft schist. About 20 men are at work on the location. A hoisting engine and drum are in operation.

#### THE MEXICAN MINING COMPANY.

The Mexican Mining Company is an organization which has been lately made to further explore and possibly to purchase the Carr mine, situated further up the hill south of the Grand Rapids mine. The description is the N. W.  $\frac{1}{4}$  of Sec. 33, T. 47, R. 26. In 1873 the mine was worked and a few thousand tons of lean ore gotten out and shipped, since which time it has been idle. I visited the location, but did not see anything very promising in the way of mineral. Further exploration, it is said, will be made. At present nothing is doing.

The Superintendent is Geo. Berringer; Secretary and Treasurer, Geo. W. Hayden, Ishpeming, Mich.; President, W. F. Swift, Ishpeming.



## THE NEGAUNEE MINES—(JUNE, 1882).

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Within the limits of the city of Negaunee, and situated a short distance south from the business portion of the town, are a number of mines commonly known as the "Negaunee hematites." The most westerly of these, on the south side, are the South Jackson and the Inn Cliff's Section 12 mine, mention of which has heretofore been made in describing the mines of those companies.

### McCOMBER MINE.

Adjoining these on the east is the McComber mine, comprising the N. W.  $\frac{1}{4}$  of the N. W.  $\frac{1}{4}$  of Sec. 7, and the S. W.  $\frac{1}{4}$  of the S. W.  $\frac{1}{4}$  of Sec. 6, T. 47, R. 26. The mine has been quite fully described in previous reports, and still continues to be one of the leading hematite mines of this range, both as regards the quantity and the quality of its ore, though the quality is now hardly up to its earlier standard. Its output in 1881 was 28,051 gross tons, and its total shipments to date amounts to 252,345 tons.

In the report of 1881 it was mentioned that a very promising pit had just been opened near the southeast corner of the engine house. This pocket has since been worked out and did not prove to be of much magnitude, but a leader trending to the northeast, past the southwest corner of the engine house, is now being opened, and may lead into a similar or larger deposit. Seventy-five feet further to the southeast they have sunk a shaft which is in good ore, the deposit apparently making parallel with the ore at the engine house.

Within the year they have begun to work underground in the easterly pits. North of the engine house 150 feet, in line with its west end, is a "down-right" shaft of 169 feet deep, and at about 223 feet to the west of this is another vertical shaft a 109 feet deep. Both these are connected to the depth of the latter, and the ore in the upper levels, except pillars, has been removed. In the bottom from the east shaft, they have drifted north 25 feet, coming in that distance to a soft rock, which was followed out 60 feet, the last 30 feet being in ore, which still continues and is likely to do so beyond the west shaft, since such was the case in the levels above. To the south a drift 35 feet was run all the way in rock—jasper—after which ore was reached, into which they have pushed 30 feet, and now have at the end of the drift a breast of ore 14 feet high and about the same in width. The jasper appears to be coming down on the northeast side, but the opposite side is still unaltered. In this east shaft, also, a drift has been opened a 100 feet in the direction of old No. 2 pit to the east. The drift is a mixed hematite rock. Also a drift 25 feet to the west, which was in ore but terminates in rock. The bottom drift to the west is 40 feet below the west shaft and to the most of it 25 feet when opposite the shaft they will drift south to it, and rise up to the bottom of the shaft. A drift has been extended west to the boundary, 50 feet west of the west shaft. This shaft is called No. 8, and the last one No. 3.

The most productive parts of the mine at present are Nos. 2, 3, and 5 pits, No. 3 being the main pit. In this pit, in the 143 feet level, are three good stopes—to the west, southeast, and to the northwest. Each of these stopes is about 14 feet high and of an equal width. Above the level in this pit they are only scrambling.

No. 5 is now the last working pit of the mine. Its direction is northwest and southeast, having a length of about 300 feet and a depth of 100 feet, and 50 feet wide in the middle, narrowing at the ends, giving it an oval shape. From this they are now taking 60 to 70 tons of ore per day. They are stopping at the west end and sinking in the bottom. The dip of the ore lines is about 45° to the south, and it varies in width from 12 feet to 60 feet, with a length of perhaps 300 feet. There is considerable ore in the north wall. It is mixed with rock, but looks as if it might pay to take it down and sort out the ore. The hoisting in this pit is done with buckets and two derricks, worked from the engine house. The surface has been stripped beyond the east end of the pit above the ore, which a thin wall of rock separates from the main pit. This rock will be taken down and the pit continued east. The ore all goes into the ore pockets, of which there are four, placed above the railroad track, and the cars are filled from under these pockets.

Up on the hillside, 600 feet to the south, some men have just uncovered a body of apparently good ore. No sinking or other test has been made in it. As exposed it is 12 feet wide.

The mine was opened in 1870, and has since been continuously worked. The ore is of an excellent quality, and sells readily in the market, being suitable for Bessemer iron.

The Local Agent is Henry Merry, Jr.; Mining Captain, Charles Cook.

#### THE PENDILL MINE.

The Pendill Mine is situated but a few rods south of the Union Depot in the city of Negaunee. The stock pile and ore pocket are close to the main track. The mine is also north of the McComber, the estate being the W.  $\frac{1}{2}$  of the S. W.  $\frac{1}{4}$  of Sec. 6, owned by the Hon. J. P. Pendill, of Marquette, but held on a lease by the Union Iron Company.

The mine was opened by Wm. C. McComber in 1877, who mined that year 4,000 tons of ore. During the succeeding time, until 1879, the mine remained idle, when it was worked for one year, until April, 1880, by the McComber Iron Company. In 1880 the company now working the mine became possessor of the lease, and has since held it.

The mine was never worked in an open pit. A shaft was sunk from the surface and is now 195 feet deep, on an inclination of 80° to the west. It has been worked in levels of about 25 feet apart. The bottom is now called the 6th level, and is looking poor. They have drifted east from the shaft about 80 feet, and are now drifting north in the 5th level, 175 feet down; to find the Jackson vein have gone 60 feet. No ore is now being hoisted. There are no stopes to mine, and no ore in sight to sink or to drift into; however, the mine is a very small, underground affair, and has before looked as unfavorably as it does now, and afterwards recovered. The ore is a good quality of hematite.

The officers are: John Burt, President, Detroit, Mich.; Hiram Burt, Secretary, Marquette, Mich.; Richard Bryant, Superintendent, Negaunee, Mich. The product for 1881 was 13,586 tons, and the total to date is 34,094 tons.

## THE NEW YORK HEMATITE.

The New York Hematite is another name for what was formerly called the Grand Central Mine. It is southwest from the Pendill, or northwest of the McComber, on the adjoining land. The company have worked an open pit a short distance east from the old Grand Central Mine. This pit has a direction of northeast and southwest, 80 feet in length on its bottom, and 20 feet wide; the depth is about 60 feet. The bottom is partly in ore, and a drift to the south 25 feet is in ore; also one of same length to the southeast showed very well in ore.

These drifts are in the bottom level. In the bottom they are now sinking for a stope, and are also removing the dirt which has fallen down from the sides in considerable quantity through the action of frosts and spring rains. Two skip tracks go down into the pit from the east side, operated with wire rope from the engine house, standing 150 feet to the east. This mine is in the S. E.  $\frac{1}{4}$  of the S. W.  $\frac{1}{4}$  of Sec. 7. Another similar pit to the east is temporarily idle, through failure of machinery, partly, and partly through the unsatisfactory condition of the deposit.

The company, or J. Q. Adams and James Foley, the holders of the lease, are exploring on the next "forty" to the east with such success that the claim is made that they found the eastern continuation of the Jackson hard ore vein. They have put down three drill holes, with the Akron churn drill, to the ledge, and think that they have the vein 75 feet wide, and have also gone east and west on it 190 feet. The ledge is covered with 16 to 18 feet of drift. The drill hole cleanings certainly showed very fine, hard ore. A shaft has been begun and is down on the ledge, showing mixed ore on top. If it proves to be really a fine, hard ore deposit it will be an important fact. Much search has from time to time been made for the Jackson ore to the east of that mine, but has never been found unless, indeed, this discovery proves to be it. The further outcome excites some interest at Negaunee.

## THE MANGANESE MINING COMPANY.

The Manganese Mining Company holds three forty-acre lots in Sec. 7, lying east from the McComber, and between the Milwaukee, the Rolling Mill, on the south, and the New York Hematite on the north. Mr. J. W. Schadt, of Negaunee, who controls the lease of the land, has given "options" in the east and the middle forties.

Some men are at work under Capt. Roberts opening a pit and sinking a shaft on the west forty, but, as yet, have not enough ore in sight to assure them of having a mine.

The middle forty, joining the Rolling Mill Mine, is being explored by Mr. Foley for Mr. James H. Dalliba, of Cleveland, O., who has an option for the lease of the land, the consideration being, it is said, \$25,000. A shaft 25 feet in depth has been sunk to the ledge, and 40 feet of drift made across it; 28 feet of the drift is declared to be in ore.

## THE CHICAGO MINE.

The Chicago Mine is the southeast forty of Sec. 7. The mine has been opened but little over a year, and shipped last season 5,531 tons of ore, and now has about 2,000 tons in stock pile. The workings have extended under-



ground, but were so filled with water at the time of my visit to the mine, (June 3), that I was unable to go down into the mine. It was represented by the men in charge to be looking well, and that mining work would be resumed as soon as the pumps were repaired and the mine freed of water. The mine is provided with a hoisting engine, and drums, etc., and has a large ore pocket standing above the railroad track.

#### THE ROLLING MILL MINE.

The Rolling Mill Mine is now idle. It was one of the best hematite deposits that has been discovered on this range; but the old mine worked out, and the pits were allowed to fill with water. An effort was made last season to pump it out, but the machinery proved inadequate and the attempt was abandoned. Some exploring is now being done to try and find a new deposit. The mine is owned by Mr. Luther Beecher, of Detroit.

#### THE STAR MINE.

The Star Mine lies east of the Chicago and the Rolling Mill Mines, in Sec. 8. It is in the Cedar Swamp, between the bluffs.

It is a new enterprise undertaken by Mr. J. B. Maas, of Negaunee, in the summer of 1881. Several shafts have been sunk, one to the depth of 60 feet, and considerable drifting has been done; enough to determine the existence of a body of hematite of some magnitude. It is but a short distance to the mineral branch of the Chicago & Northwestern Railroad.

A force of 22 men, under Capt. John Bartle, are now at work to open a mine, no easy task in this low ground. Shafts will be sunk and underground mining resorted to from the outset.

The Agent is Ed. Maas, Negaunee, Mich. The property consists of the W.  $\frac{1}{2}$  of the S. E.  $\frac{1}{4}$  Sec. 8, T. 47, R. 26.

#### THE BAY STATE MINE.

The Bay State Mine is the name under which is known what was formerly called the Green Bay, and latterly, the Indiana Mine. The property is the W.  $\frac{1}{2}$  of the N. W.  $\frac{1}{4}$  of Sec. 8, and is controlled by Messrs. Allen & Blake, of Negaunee.

Considerable mining has been done on this location, but not much good ore obtained. The ore that was shipped in 1872, 1873, etc., was of a very low grade; a jasper hematite that could not now be sold at any price.

The new company, the Bay State, was organized, some 10,000 shares of the stock were sold, and work was begun May 1 last, and they are now employing 18 men engaged in sinking a shaft, near the east line, in some of the earlier workings. This pit is down about 20 feet, in mixed ore; they have a small engine hoisting. To the northwest, on the other side of the high knob that intervenes, they are making a long cut to reach a body of ore into which a shaft has been sunk a distance of 16 feet. This deposit they have crossed, showing a width of 30 feet, and have tested its length for about 100 feet.

This land was leased in 1879 by Wm. J. Allen, and himself and Mr. Blake have since worked it, calling it first the Indiana; but learning there was already a company having that name, changed it, recently, to the one above



given. Mr. Allen directs the work; he is an old worker in this vicinity, and has done a good deal of unavailing exploring about Negaunee, but is now confident of success. In 1872-73 he operated what was called the Allen Mine.

#### THE ALLEN MINE.

This old mine, lying next east from Green Bay, Thomas Tracy, with some others, is exploring. They have chosen a place where formerly some work has been done, and are preparing to sink a shaft in a ledge of mixed ore. As they have been but a few days at work, there is of course but little to show.

#### THE MILWAUKEE MINE.

It is still a matter of regret among not a few of the explorers and investors at Negaunee, who for so many years have, with industry and persistence, pick and shovel in hand, worked Sec. 7, testing its outcrops and perforating its out pits; or with equal faith and temerity have invested their limited surplus in "promising funds" that in the end, perchance, brought only loss and disappointment; that they had not the discernment to know that way up on top of the hill, surrounded on every side by the greenstone, was, perhaps, the richest deposit of them all. In the center of the section, on the "forty" on which they had neglected to secure an option, from esteeming it valueless, was discovered one of the largest deposits yet opened on this range, and which indeed proved a bonanza to its fortunate holders, and has, apparently, been a no less valuable possession to its subsequent owners. The discovery of the ore, analysis of its properties, and a description of the mine were fully given in the last annual report; and it is safe to say that the mine has thus far realized all that was reasonably predicted regarding it, and that its outlook for the future is equally good. The mine is in the center of the "forty," west of the Rolling Mill Mine, and southeast of the McComber, and high above them both.

The railroad to reach it starts from the east and traverses a long, high trestle on an ascending grade, reaching a depression on the hillside, at a considerable elevation, at the now idle workings of the Manganese Mine, thence by a wye it winds around the east and south sides of the hill at a steep grade, until it attains to the mine. And yet, when the mine is reached, it appears to be in a sort of a basin in the top of the hill. There are walls of greenstone to be seen in nearly all points of the compass.

Like others of the Negaunee hematite mines, the Milwaukee is a succession of open pits of a magnitude corresponding to the extent of the deposit, which has been or is working. Those from which the product is now obtained are Nos. 2, 3, 6, and 7 pits. The others are either wholly idle or occupied by scammers. A small amount of ore is obtained from No. 1 pit and is trammed through into No. 2, which is now the most westerly pit. It is about 100 feet long, 40 feet in width, and 100 feet deep.

The shaft goes down from the southeast side on the foot-wall. The skips discharge into the tram cars at the top, which are run to the pockets. From the bottom of the open pit the shaft is sunk 40 feet, and they are going to push the work underground.

In the open pit the ore was capped over and worked out in the winter and the surface, etc., above allowed to fall in. The shaft is in the foot-wall 5 feet from the ore; they have cut through and around the ore 10 feet, and come to

soap rock; the drift will be pushed through this, as it is doubtless only a partition in the ore, since in the levels above the same thing occurred, the ore appearing south of the schist and widening. On the surface the ore was narrow, now it is 10 feet.

From the bottom of the shaft in this pit they have drifted west 115 feet, in ore all the way, and come to soap rock. Also a drift a little to the northwest 150 feet, was all in greenstone when they cross-cutted 35 feet, but found no ore. This drift and cross cut will be extended when they have the facilities of getting out the water which now interferes with the work.

No. 3 is a long, ragged pit, 600 feet north of No. 2, with a south wall of mixed ore. Little holes or pockets are now being mined out in it. The open pit is 50 feet deep and the shaft is 90 feet below the bottom. The skip road goes down from the northeast side and extends to the bottom. Underground the vein is 75 feet long and 20 feet wide, but is a little mixed. They are working the level and have a stope the full length and width of the vein and 40 feet high. The bottom is in ore; they have sunk 20 feet below the level and find it the same.

The pit now furnishes 15 to 20 tons per day. A track runs from the top of the skip road to the ore pockets over the railroad.

The ore from the mine is sold to a considerable extent to local furnaces. Twenty-five cars per week are sent to the Martel furnace, St. Ignace, and as many more to the Excelsior and Carp furnaces. The mine makes barely enough water to keep the pumps going.

No. 6 is a small pit, the open part being about 70 feet across and 50 feet deep, in the center of which, below the bottom, the shaft goes down to the southwest. To the southeast is a run of ore 8 or 10 feet wide, which they are stripping from the pit to mine. It appears to be widening out; where it starts from the pit it is small, but as uncovered, it now shows a width as above indicated. Below the bottom the shaft goes down 75 feet, and they have an underground pit with a deposit of ore of the same length and 20 feet wide, while they are taking all out except the pillars. The vein is much cleaner than in No. 3. The ore requires but little sorting in this pit.

No. 7, about 300 feet east from No. 6, is the most northeasterly pit in the location. It is really divided into two open pits, the west one of which is idle, temporarily, but is not worked out as the bottom is ore. The east pit is about 100 feet long by 75 feet wide and 40 feet deep. The ore has a width of 30 feet at right angles to the walls, and is very clean, free from rock, etc. When a bunch of jasper does occur, it is isolated and easily separated from the ore. The underlay is a jaspery hematite, and the ore makes into it.

The ore appears to extend south of this pit, beyond the rock that they are now following down as the foot wall. At the west end the deposit makes an elbow, cutting across the formation to the south, and has been followed 50 feet. Another branch of the ore appears to be making towards No. 6, but has not been followed.

The hoisting from No. 7 is done with a small engine and drum situated to the south. The ore, as in the others, is trammed in the cars, into which it is dumped, to the main pockets. This pit is yielding a daily product of about 75 tons of ore, the total weekly product being about 800 tons.

To the west a few men are at work on a small deposit from which they have got out about 150 tons, and are working to see what may develop.

In No. 5 pit, lying south of Nos. 6 and 7, they have in the east end a vein

of ore 10 feet wide, which they are stripping; it seems to be making toward No. 7. In that same pit, No. 5, there are two long cuts to the south, which afforded very fine ore. There are three double, equal to six single ore pockets, having a total capacity of 120 tons. These are connected by rail track with each of the shafts, and stand above the railroad, so that the cars are filled from the pockets.

The ore from all the pits is mixed together and sold as a 58 % ore; it is not found to be, on the whole, suitable for Bessemer steel, though all the ore, except that from No. 2 pit, would probably answer for this purpose. Some complaint was made last year by the purchasers of the ore; it was sold for a too high grade ore, so that it is thought best to place it at a standard that will be sure to give entire satisfaction. The product last year was 31,365 gross tons, and will be fully equaled by the output of 1882. The aggregate yield of the mine during the two years that it has been worked is 45,448 tons.

The General Agent of the company is Mr. A. Kidder, of Marquette; local Superintendent is Capt. James Foley, Negaunee; Mining Captain, Gilbert Carmichael, Negaunee.

#### THE WEST REPUBLIC MINE.—(JUNE, 1882).

This mine is in a small peninsula made by Smith Bay on the east and the Michigamme River on the north and west. The mine, as opened, is near the river, on the west end of the peninsula, and the underground workings already reach the east margin of the river.

The M. H. & O. Railroad Co. has built a track into the mine, starting from the Columbia and Kingston branch, and making a circuitous route on the west bank, it crosses the river to the east side a few hundred feet to the north of the mine. Two large ore pockets are building by the side of the track, and strong framed stretchers over the mouths of the shafts for the skip dumps, etc.

No. 1 shaft was sunk off the vein or ore. It is 125 feet deep and will not be sunk further, as the ore pitches away from it, and can be better reached from the other shaft. For some time it will answer for taking down timber, etc., and ventilation.

No. 2 shaft is also vertical; it is 135 feet deep below the surface, and about 100 feet from the east bank of the river. The main lens of ore in which they are now working is pitching rapidly under the stream. The ore is 30 feet wide from foot to hanging, and 90 feet in length. They have two stopes working in this lens, in two levels. It has been widening rapidly, and if it continues to do so at the same rate it will be in another level or two attain a width of 50 feet. They have commenced to sink for the vein on the west side of the river.

A good engine house has been built, and a hoisting engine, 2x5 feet drums, etc., erected in it. A large number of good houses have been constructed. The location is a very pleasant one, to the beauty of which very much is contributed by the large bay and river.

It is but a short distance from the westerly pits of the Republic Mine. The ore is a fine specular slate, identical with that of the Republic.

The mine is in Lot 4, in Sec. 7, T. 46, R. 29, though the company holds Lots 4, 6, Sec. 7, and Lots 2, 8, Sec. 18, T. 46, R. 29. The officers of the company are: E. G. St. Clair, President, Ishpeming, Mich.; Mark Hanna, Secretary and Treasurer, Cleveland, Ohio; J. O. St. Clair, Superintendent.



The product in 1881 was 7,354 tons, though the company did not ship until about August. The probable yield for 1882 will be 20,000 or 25,000 tons.

COLUMBIA IRON MINING COMPANY.—(JUNE, 1882).

In a quiet way, under the new management, this mine is gaining in public estimation and in value. It is so near the Republic Mine that it is, of necessity, far overshadowed by it, and its deposits of ore, naturally, appear small and contracted when compared with those of its neighbor; nevertheless the Columbia is holding its own and gaining ground. The output for 1881 was nearly double that of the preceding year, and some results obtained from the explorations with the diamond drill are greatly encouraging, and add a prospective value, enhancing that given by the promise that is based upon what may be seen.

The Columbia adjoins the Republic on the north, the property being held by the present company on a lease from the owners. The mine openings extend along the vein, or ore deposit, a distance of about 1,000 feet, and comprise six pits, numbered from 1 to 6, commencing at the south. The south pit, No. 1, is about 150 feet distant, north, from the Kingston pit, the most northerly of the Republic Company's workings. The ore is of the same character, being slightly mixed with visible specks, or with small seams of quartz or jasper. It is all an excellent second-class ore, and some of it, by sorting, makes a first-class ore. No. 1 pit is now down to a depth of 145 or 150 feet. The pit is upwards of a 100 feet in length. The width of the ore is from 8 feet to 12 feet, being widest in the middle and narrowing towards the ends, though at the north end it about holds its own in width. The vein has a vertical dip and bears northwesterly. The walls are very firm. A diamond drill hole started at 140 feet southwest from this pit at an angle of 60° dip pierced the vein at 112 feet below the bottom, passing, it is claimed, 20 feet of No. 1 ore.

The Kingston pit, to the southwest, is improving both in the width of the deposit and in the quality of the ore, and it is inferred that the Columbia No. 1 will do so likewise, when the same depth is reached. The results from this drill hole, and the experience in the pit itself, indicate that such will be the case.

No. 3 pit is 140 feet north of No. 2, or 187 feet north from No. 1. It was apparently exhausted, but a new lens was found by crossing into the hanging, affording a working deposit 100 feet and upwards in length, and 8 feet or 10 feet in width of No. 1 foundry ore.

No. 6 is the extreme northwesterly pit. The vein at the bottom is about 8 feet wide and extends under the lake, as is shown by a drift made in the deposit in that direction a distance of 75 feet. The ore in this pit is of better quality, being sold for first-class, by some sorting. They are sinking and stopping in this pit, the lens, evidently, as do all of them, pitching to the northwest.

No. 3 is about midway between No. 1 and No. 6. The mine is provided with a suitable plant for present purposes, to which has just been added a compressor for working air drills. There are about thirty good houses on the location. The diamond drill is kept constantly at work. The product for 1881 was 11,158 gross tons, and the aggregate to date is 82,033 tons.

The officers are: P. B. Shumway, President, Chicago, Ill.; B. H. Jones, Secretary and Treasurer, Chicago, Ill.; C. M. Wicker, General Manager, Republic, Mich.



## THE ERIE MINE.

This mine lies northwest from the Republic, on the same range with the Columbia, and distant about five miles. The mine is in the southeast part of the N. E.  $\frac{1}{4}$  of the N. W.  $\frac{1}{4}$  of Sec. 28, T. 47, R. 30. Some work has been done here for several years back, and a few hundred tons of ore gotten out and hauled to the railroad in sleighs and shipped.

The present company was organized and began work about one year ago, and have taken out and have in stock 2,000 or 3,000 tons of good second-class ore, similar to that from the Kingston pit, but of not quite as good a quality. Two downright shafts have been sunk. No. 1, the northerly one, is 125 feet deep. In this shaft, in the 74-foot level, a chamber 30 feet square and of about the same height has been mined out, and the ore vein, 12 feet to 16 feet wide followed to the southeast 35 feet. Running northerly from the shaft is a short drift, 15 feet long, cutting a narrow vein of ore. The shaft is sunk 50 feet to the second level.

No. 2 shaft, 60 feet distant from No. 1, to the southeast, is sunk 61 feet. In the shaft is a narrow vein, which runs in the cross-cut to the east, but has been but slightly followed. A boring has been made from the north dipping to the south, under the mine, at an angle of 60°, which at a distance below the surface of 200 feet, it is claimed cut 30 feet of No. 1 ore. They are anxious for the M. H. & O. Railroad Co. to build a track into the mine, which work is contemplated.

E. H. Wright, Agent, Republic, Mich.

## THE REPUBLIC IRON COMPANY.—(JUNE, 1882).

The Republic Mine has for years been esteemed one of the richest possessions in the iron region. In the estimation of nearly every one it has been placed in the front rank of the iron mines in this country. Its ores have been the standard for first quality in the market. Republic ore is the synonym for the best that can be produced. Its management is cited as of the best; its stocks command the highest price; its revenues are larger, and its aggregate profits greater than those of any other iron company. To hold stock in the Republic is to possess a coveted treasure, and an assured income.

The situation of the mine is by nature one of the most pleasing and romantic spots to be found. The Michigamme River, a stream of considerable size, has here a very rapid current, foaming over and among the rocks which obstruct its flow; but above the rapids, in full view from the location, the river spreads out into a broad, magnificent stream, which disappears to the north, between the rugged hills that come down to its margin and finally obscure it from view. Here, too, are several beautiful bays, formed by depressions in the surface adjoining the river, and high up in the northerly and westerly slope of the bold, rocky bluff which, at a few hundred feet distance, surrounds on two sides the largest and clearest of these placid sheets of dark blue water, are the shafts of the Republic Mine. The openings are along the hillside, at an elevation of about 100 feet above the bay, and 50 feet below the top of the perpendicular wall, which rises abruptly to the rear. The trend of the bluff is in the form of a hook with the long branch north and south, and the bend coming around from the south end to the west; but in this general base are several minor loops or upright folds in the formation.

The shafts or openings extend for a distance along the interior face of the

bluff, of upwards of half a mile, and are sixteen in number. Commencing at the westerly extremity, with the Perkins, they are named in order of occurrence, proceeding to the east and north: Morgan, Pascoe, Ely, Gibson; thence by numbers from 1 to 11. And further to the west, on the opposite side of the river, about a half of a mile away, is the Kingston pit.

Commencing with the Perkins, at the other end of the line: this is not a large pit. Its product is shipped under the brand, red ore. It is a hard, specular ore of good quality, but distinct, having when struck or rubbed a slight reddish cast. The pit is 175 feet deep from the surface, about 35 feet long, the width of ore about 12 feet. It has been idle for eight months until recently, when work was resumed in it. It is worked with bucket and derrick. The Perkins is separated from the Morgan pit by a crossing of jasper. This latter is 200 feet to the east, and 132 feet further is the shaft of the Pascoe pit. The two pits are connected and are similar. Near them is an engine house furnished with hoisting engine, four of Merritt's internal friction gear drums, five feet diameter.

The Pascoe pit is furnished with a double skip road, the Morgan with single skip and pump shaft.

Going to the Pascoe and descending in the skip to the fourth level we find, northeast from the shaft, a stope of ore 100 feet long and 12 feet wide. A conglomerate generally underlies the quartzite, between it and the ore. A short cross cut, 20 feet, through jasper brings us again into a large body of ore, opened for stoping. Upon each side of the shaft are pillars of ore, left to protect the shaft. The same course is pursued in the other levels. The peculiar feature of the Pascoe pit is in the lay of the lenses of ore. They occur on either side of the shaft, extending east, west, and south, the long axis across the formation. The shaft goes down between these main lenses—they cut through the jasper. Going down to the fifth level, which corresponds to the seventh of the Morgan pit, we came into a small chamber with a drift off to the east, 50 feet, partly in jasper, to the east line. To the west a short drift in jasper brings us into the ore, a narrow lens across the formation. These lenses appear to have originally conformed with the formation, but in the disturbances that subsequently occurred, the formation at this point has been squeezed together, folding one portion into the other and setting some portions, in which these lenses are included, on end, they have been turned up on edge and thrown around the long way across the formation. A drift to the west, in this level, through the jasper connects with the Morgan pit. The 6th level has been sunk, but the skip road has not been carried down below the 5th. The method of sinking the shaft is by first sinking a winze by the side of it, between the shaft and the pillar, using one of the little hoisting engines described in the Michigamme Mine, "puffers," Capt. Pascoe designates them. The sink is thus made by hoisting to the skip, and when all is completed ready to stope in the level below, the shaft is lined up, the skip road completed to the bottom, and the connection made.

Passing west through the drift we come into the 7th level of the Morgan pit. Here is a large chamber from which the ore is taken out, to the north, 40 feet in the hanging rock wall, and they are drifting to the west around a huge pillar of ore that will be left. West of this pillar is another large chamber worked out, the south side of which is a jasper wall, but in the west end is a fine stope of clean, rich, black ore 40 feet high and 25 feet wide. On each side of the shaft are pillars of ore.

In this, as in the other pits, when the deposits are of sufficient magnitude to admit of it, the general plan of working is to have 30-foot pillars of ore on each side of the shaft, and then mine out a chamber 30 feet wide, again leaving a 30 feet pillar; thus pillars 30 feet square are left each way, 30 feet apart. The bottom of this pit is 260 feet below the surface, or 187 feet below the surface of the water in the bay.

Ascending to the surface in an up-going skip we pass southeasterly to the Ely pit. This pit is thrown back 100 feet into the foot wall from the Pascoe and Morgan. The dip is to the northwest about  $55^{\circ}$ , and the collar of the shaft, which is 380 feet above the bottom of the mine, on the lay of the skip road, is also 87 feet above the bay. In the lower levels, in this pit, they are working a lens which is about 140 feet in length and 40 feet to 50 feet wide.

From the Ely to the Gibson pit, 400 feet distant, occurs another sharp loop or ox-bow. The formation is folded back upon itself, so that the direction of the workings are the long way north and south, jutting into the jasper foot wall, but the jasper is likewise folded so as to conform with the ore lens. The ore lens pitches northeasterly  $40^{\circ}$  to  $50^{\circ}$ ; the direction would be across the formation, if the formation continued regular. There are really two lenses worked in this pit, both pitching the same way. The back one is about 30 feet long and 5 feet wide. The front one is 75 feet long and 7 feet wide. The shaft is 380 feet deep, thus making it nearly 300 feet below the surface of the water in the bay. The product is a fine, specular slate ore.

No. 1 and No. 2 shafts are around the corner, which the line connecting them makes with the line from the Gibson to the Ely. The distance to No. 1 is 100 feet. The direction of the pits is east and west, and they front to the north. They were both poor on the start, but have improved greatly since they were started.

The underground workings in these two pits are the most regular of any to be seen in the mine; they are more like the copper mines, to use Capt. Pascoe's expression, who by the way was a miner in the copper district before coming to the Republic. The levels are systematically laid out, occurring in regular succession, one below the other, and opened out the whole length from one end to the other. No. 2 shaft is 91 feet above the bay. The dip is northwesterly  $55^{\circ}$ , and the depth to the bottom 350 feet.

Going down in the skip to the 6th level, we find a vein 7 feet wide, and 30 feet east from the shaft a stope 70 feet high; passing to the west along the level we may go directly into No. 1 pit and beyond the shaft 70 feet or 80 feet till the bend is reached going around to the Gibson, where the ore is cut off. In this pit the vein is 20 feet wide. The lens dips to the north and to the west, so that it lengthens and widens with each successive level. They are putting into this shaft, No. 1, a large plunger pump. No steam is used anywhere in the mine; all the drills, "puffers," pumps, etc., underground, and some of the hoisting engines above are run by compressed air.

As the power to compress the air is largely supplied by water, this measure is a matter of economy, but chiefly it is a necessity in ventilating the mine; it would be impossible to use steam in these pits without interfering with the work. Both No. 1 and No. 2 shafts are sunk to the 7th level; pillars of ore are left upon either side of the shafts.

Ascending No. 1 to the surface we pass to No. 3; from No. 2 to No. 3 the direction is north and south, but at No. 3 it bends off to the northwest again. This shaft is worked down to the 5th level, but only ore from No. 4 is hoisted



from it. It is practically worked out. The pitch of the lenses have so brought it and No. 4, under No. 5. The ore has passed to No. 5 shaft. Thus this part of the mine is making to the north. The one from Nos. 3 and 4 pits is hoisted in No. 5 shaft mainly.

From the shaft of No. 2 to Nos. 5 and 6 shafts is about 550 feet. These two pits are entered by a downright shaft fitted with a double iron cage lift. The collar of the shaft is 108 feet above the level of the bay. Stepping upon the cage we may easily and safely descend to the 6th level, 360 feet down. Here we see the Republic in all its magnitude, the deposit which has given to it its great celebrity, a hundred feet from foot to hanging of the finest ore. In these pits for a length of 400 feet we have an average width of ore of 70 feet. Each successive level is but a counterpart of the preceding one; there are no signs of exhaustion. It is unnecessary to attempt to describe it; it is only a matter of immense chambers, pillars, and vaulted arches. In each level, upon each side of the shaft, are the great supporting pillars of ore, beyond which, either way, occur in succession the chambers and pillars as the mining work is extended.

From the shaft an avenue 30 feet wide is cut through to the hanging wall, and in the same manner, at each 30 feet, in the direction of the vein, parallel channels 30 feet wide are opened across the vein, from foot wall to hanging wall, and at each 30 feet between these blocks cross cuts, 30 feet wide are made. Thus the whole level in both pits is blocked out, leaving in the pillars and arches that remain, nearly one-half of the ore. In the meantime the shaft is dropped another lift by sinking a winze by the side of it and opening out the size of the shaft, the bottom being securely covered over with timbers. When all is ready the timbers are removed and the skip can go to the bottom. The specular slate and the black ore are separated by 15 feet of soap rock. The former underlies.

The ore lenses pitch to the northwest, so that at greater depth these lenses will come into Nos. 7 and 8 shafts, etc.

From the surface back from Nos. 3 and 4 shafts some men are working two small scam pits. From the No. 4 the formation runs about north between Nos. 4 and 5; is a long, open pit 200 feet in length, 70 feet or 80 feet wide, and 150 feet deep.

To the north the several shafts are entered by adits from the west, out from which the ore is trammed with mules to the docks or pockets, after being received into the cars from the skips. No. 7 and No. 8 are the two most important of these northerly pits. The vein is here narrow and vertical, and frequent spurs of ore jut into the jasper foot wall.

These shafts, 7, 8, and 9, are worked by a compressed air engine in a building upon the top of the bluff 50 feet above. In it are two four-foot drums and one six-foot.

Pits 10 and 11 are comparatively of but little account. Kingston pit, on the opposite side of the river to the north, is a mine by itself, with its own plant, hoisting engine and compressor, and furnishes a second-class ore.

The hoisting in 3, 4, 5, 6, and partly from 7 is done from the main engine house situated near No. 5 shaft. The hoisting machinery now in use in this building will be replaced with four 12-foot drums, etc., now making at the Iron Bay Foundry Works, Marquette.

A novel feature in working the machinery at the Republic, heretofore fully described in the previous reports, is the extended use of compressed air in



working the engines, etc., the compressing power being mainly water furnished by a dam across the river about a mile below the location. The compressed air is brought to the mine in a 15-inch galvanized pipe, with which all the compressor pipes in use in the mine, large and small, are connected. It is thus a receiver. At the water works are four compressors, also a double engine to assist in driving them in the season of low water. At the mine are four small compressors, driven each by a single engine. Twenty-five air drills are worked in the mine, four of them Rand's, and the others, Ingersoll. Twenty-four Cameron pumps are used, run by compressed air.

The compressors at the mine are each 13x30 inches, and the four at the water works are each 24x60 inches. There are six double engines, five for hoisting and one at the water works; two pumping engines on the surface 18x24 inches and 22x36 inches; these work the plunger pumps. There are six small "puffer" engines, and a single engine running four drums at No. 5. Besides the twenty-four pumps in the mine there are 13 others, either in use on the surface or kept for emergencies—thirty-seven in all. There are twenty ore pockets situated at different points above the several tracks, as convenience dictates. These pockets are of course over the tracks, so that the cars run under them. The ore docks are on a level with the top of the cars, so that the ore all goes down to the cars, whether from the pockets or from the docks.

Another very important feature connected with laying out the yard has been observed. From the extreme southwest to the west end of the yard a down grade has been given to the tracks just sufficient to move them down to any point by the force of gravity alone. The locomotive, which pushes in the train of empty cars, leaves them upon the track to the west of the mine; they may then be uncoupled and allowed to run down, be switched upon any track, and thus guided to any point, as desired. No switch engine or switch team is used. When filled the break is taken off, or blocking removed and the loaded cars are run out on the way track below the mine. So handily does the system operate, and so well are the pockets and docks distributed that 404 cars have been loaded in ten hours. The daily product is now between 700 and 800 tons.

Mr. David Morgan, the General Manager, has given his personal attention to the affairs of the mine; his long experience, mechanical, and executive ability have been invaluable to the company.

The Assistant General Manager, Mr. W. D. Rees, is known as a very competent, experienced mining agent, and withal an obliging, accomplished gentleman.

Capt. Peter Pascoe, the local Superintendent, has held his present position since the first blow was struck in opening the mine, and that he has performed his varied and responsible duties with ability and fidelity is fully attested in the appearance of the mine and in the esteem in which he is held by both his superiors and subordinates.

The shipments for 1881 were 233,786 gross tons, and the aggregate is 1,425,319 tons.

#### THE BARON.—(JUNE, 1882).

All the operations at the Humboldt Mine have been transferred to the "new discovery," the west end mine, now called the Baron.

Here a new mine has been opened, and all the buildings and plant for its

working have been provided. The work here has continued through about two years, and though the immediate location was originally low and swampy, there are very little indications of it now; it has been filled up so that it appears as if it had been high, dry ground.

The ore vein has a strike of northeast and southwest, and dips to the northwest at an angle of about 52°. The north pit was worked as an open pit to a depth of 80 feet, but the shaft has been carried below the bottom 70 feet lower, underground; 50 feet of this is a new level recently sunk. This new ground they have for the summer's stoping in this pit. It has a length of about 50 feet, in direction of the vein, and is about 12 feet wide, and pretty free from rock. Heretofore they have hoisted from this pit with a bucket and derrick, but soon this method will give way to the skip. A skip road is nearly completed from the top of the new ore pockets, of which there are two, to the bottom of the pit, and in a few days will be in readiness to operate.

No. 2 pit is 120 feet to the southwest, and is down 150 feet, whole length of the skip road, but only 90 feet below the surface. The lower level was sunk last year. The first level to the south from the shaft 65 feet proved to be poor. The lower level has not been much tested in this direction; but the best ground is found to be between the shafts.

It averaged, in the first level, 6 feet to 8 feet wide.

The second level, now opening out, appears to be about the same,—the vein 6 feet to 8 feet wide, and the stope 50 feet high. They have used the diamond drill in the old mine, in the bottom, boring through the foot wall and hanging wall, but without any important success. No borings have been made in the new mine. They are mining about 100 tons per day, and expect when No. 3 is working to double the product. The company is working 212 men, a very large force for so small a mine, but much of the work is in the matter of construction, building new ore pockets, new skip road into No. 3, etc. Each pit will have a double ore pocket.

No. 1, still to the south, is of no value so far as known. It is 65 feet from No. 2.

No. 5, up on the bluff to the northeast, 600 feet from No. 3, is a small pit which they are working away in to see what may turn up. They have here only a small vein, 4 feet wide, into which they have sunk 60 feet. The shaft goes down near the north end of the lens, since on the north side of the shaft the ore is only 1 foot wide. They are drifting south from the shaft, but there is no variation in the width; it keeps about 4 feet. The hanging and foot walls are as in the other pits, respectively quartzite and jasper. They have a compressor, a small one, got of the Michigamme Company, and four air drills.

The machinery is from the old Washington Mine, and somewhat antiquated, but suffices well enough for the work to be done. The ore from No. 2 is a slate ore, and No. 3 produces a black ore; both are excellent, first-class ores. No rock or poor ore can be found in the stock pile.

This mine is about one mile southwest from the Humboldt Railroad station. It is on the Republic branch, and not far from the track on the south side. It is near the S. E. corner of the N. W.  $\frac{1}{4}$  of the N. W.  $\frac{1}{4}$  of Sec. 11, T. 47, R. 29.

The General Manager is John B. Maas, Humboldt, Mich., and the intelligent, experienced Mining Captain is John Hosking.

The company controls a large estate, which includes the old Washington

Mine. The product for 1881 was 26,302 tons, and the aggregate to date is 485,495 tons.

#### THE ARGYLE MINE.

East of the Humboldt, between it and the old Washington, is the Argyle Mine, formerly the Edwards. The new company began work the 15th of April, 1881, and is now working two shafts. The mine, from the time it was first opened in 1865, has been worked underground, and was the first to be exclusively worked in that way.

No. 3, the most northerly pit, is 475 feet deep on the lay of the formation; the last 50 feet were sunk last winter. They are working in this pit in the third and in the fifth levels. In the latter they have for a stope the whole height of the sink; have stoped northeast from the shaft, thus far, 20 feet. At the shaft the vein was 15 feet wide, but narrowed down to 5 feet, and is again widening out. To the southwest they have gone about 75 feet. The vein is narrow, about 3 feet wide, but seems to be widening beyond.

No. 2 shaft, to the west, is distant from No. 3 150 feet. It is down to a depth of 350 feet. The two shafts are connected in the first level; but below there is a bar of ground close to the east side of No. 2 shaft, which they have not perforated in the lower levels. In this shaft, as in No. 3, they are working the lower levels. In the bottom level, in this shaft, they are stoping down the vein to the southwest. It is opened to the southwest 125 feet. The stope in the bottom begins at 100 feet from the shaft, southwest of it; the vein varies in width from 5 feet to 10 feet. The height of the stope is 40 feet. The hanging wall is quartzite and the foot jasper; the average dip is about 50° to the north. The extent of the workings on the property from the extreme limits is 560 feet. A diamond drill has been used in the mine; one boring through the foot wall penetrated 14 feet of No. 1 ore, after going only 25 feet in the foot. To the north they are going to cross the formation, below the mine, with the drill.

The daily product is now about 75 tons. The estate comprises 440 acres, held in fee by the company.

The officers are: D. M. Dickinson, President; D. R. Shaw, Secretary; W. W. Wheaton, Agent, Detroit; Mining Captain, James Bale.

The product for 1881 was 5,584 tons, and the aggregate product to date is 224,613 tons.

#### THE CHAMPION IRON COMPANY.—(JUNE, 1882).

The Champion Mine is coming to the front as one of the richest and largest producing mines in the State. Its product last year was only exceeded in amount by that of the Lake Superior, Republic, and Cleveland Mines, while in quality of its ore it is second to no other.

The Champion has been improving from year to year as increased depth is attained. The intelligent enterprise which has characterized the management has brought to the light the knowledge of the existence of the immense lenses of ore upon which the great value of the mine depends. Few companies have been more fortunate in this respect. Ten years ago it was thought to be nearly exhausted, but now it is richer than ever, and its prospects for the possession of mineral wealth were never so good.

The south deposits are constantly increasing. The "Chimney," "The



Old Man's Deposit," and the southeast deposit, which in the upper levels were all mined separately, each with a separate cross cut from the main lens, have now all come together, making one magnificent deposit of ore. Formerly they radiated upward like the fingers that have now come into the body of the hand, and the body of the hand is this deposit of ore, 40 feet in width and 320 feet between the end stopes of the pit, and still lengthening.

There are other important facts of a greatly encouraging nature, developed during the year past, which may perhaps better be made known by going over the work somewhat in detail, taking each shaft in succession.

A shaft, to the west, still remains idle; no further exploration has been undertaken.

In No. 1 a small pocket was worked out, the same one that has been found in this shaft.

In No. 2 shaft, in the south deposit, they are stoping from the 5th to 6th level. The shaft has been sunk 90 feet below the fifth, being well on its way to the 7th level. The body of the ore has been proved with the diamond drill and opened into from the south deposit. It proves to be an immense body of black granular ore. It is believed to be the extension of the south deposit from No. 3, where first opened.

It must be remembered that the Champion was first opened in a vein running east and west, and dipping to the north  $80^{\circ}$ , with a quartzite hanging wall. Subsequently, by the use of the diamond drill in the mine it was discovered that what had been supposed to be the true foot wall was only a barrier, separating the main vein from other equally valuable lenses of ore laying to the south, and that the foot wall, the greenstone, lay to the south 140 feet distant. These north deposits and south deposits are connected by cross cuts in the different levels.

No. 3 shaft has been sunk to the ninth level, and 20 feet below on its way to the tenth. The ninth level has been opened out. To the east, in the eighth level, it is stoped out. To the west in this level it has been stoped out 140 feet, and the stope is equally as good as at any portion of the drift. This becomes a very important feature, since in the level above the ore continued to a distance west from the shaft of only 80 feet. Already it has lengthened in the eighth 60 feet, and appears likely to continue much further to the west. The ore in this part of the mine shows a strong westerly pitch in the deposits from the surface down as far as the mine is opened, of about  $70^{\circ}$  with the horizon. The shoot of ore has an east and west length of 500 feet.

In the south deposit in this shaft they are working from the seventh to the eighth levels. The opening has been a length of 320 feet, and at the west end is 40 feet wide, and constantly growing wider. To the east it is narrowing, and is now only of a width of 5 feet. The north deposit varies in width in this level, from 28 feet to 40 feet.

Between the eighth and the ninth levels the winzes on either side of the shaft have been sunk, and they have commenced stoping.

In the ninth level a cross cut from the north into the south deposit, opened into ore which has been penetrated 22 feet, and the foot wall has not yet been reached. This deposit was not before known. A winze has also been sunk from the ninth level 40 feet. Another cross cut 63 feet in length to the south passed through two new deposits of ore, one of them 10 feet, and the other 7 feet wide. They have commenced working the 10 foot vein, which is a fine granular ore. This ninth level is 600 feet below the surface.



In the south lens, between the seventh and the eighth levels, occurs the union into the main lens of the several separate deposits, which have continued down from the surface, and which has heretofore been referred to. This chimney is 100 feet east of No. 3 shaft—a cylinder of ore nearly circular, 30 feet in diameter, that has come down from the surface.

Heretofore this lens as well as the others had to be mined separately, each with its cross cut and winzes. Now that these are all together, no cross cut is required, and it becomes a very important part of the Champion Mine.

In No. 4 shaft they are mining in the 6th level in the old south deposit. The ore is trammed through and hoisted from No. 4. The deposit has shortened up and narrowed, so that there is little expectation of getting any ore below the first level; but an immense deposit of ore lies under this shaft to the west that has been proved with a diamond drill. On the direction of the hole the ore measured 86 feet, and is estimated to be 43 feet at right angles to the walls. They are coming into it from No. 3, and it dips under No. 4.

A little east from No. 4, in the seventh level, a cross cut was driven to the south 8 feet, coming into a new deposit 12 feet wide.

No. 4 shaft lies south, behind No. 3; it starts from the south deposit and works over into the north.

No. 5 is sunk from the surface through a succession of small lenses, in a chloritic or a talcose schist. These pockets have increased in size below the fourth level; they are now at the sixth level, and will be down to the seventh during the summer.

In No. 7 pit a body of ore 14 feet thick has been discovered, with a diamond drill. The ore is 240 feet below the surface, and 100 feet under the bottom of the shaft.

In the way of improvement in surface plant a new boiler house has been built, supplied with two new 6-foot shell boilers. These boilers are now supplied with water from Michigamme Lake, one mile distant, and 190 feet below the mine. The water is brought to the mine in 6-inch wooden pipe, laid underground, through which it is forced by a 6-inch plunger pump, placed at the lake. It is found that the use of this water has made a saving in fuel of \$200 per week; heretofore the use of the water of the mine filled the boilers with dirt to such an extent as to render it difficult to create steam.

A stone building is erecting to hold a duplex Raud compressor, 20x48 inches, sufficient to operate thirty-two air drills.

The product for 1881 was 145,427 gross tons, and the aggregate to date is 967,088 tons.

The mine is about one mile southwest from Champion station, on the M., H. & O. Railroad, and 120 feet above it. The distance to Marquette by rail is thirty-two miles. The location is the S.  $\frac{1}{2}$  Sec. 31, T. 48, R. 29.

The local management continues in the hands of Mr. A. Kidder, Agent, and Capt. John Pascoe, Superintendent.

#### THE MICHIGAMME MINE.—(JUNE, 1882).

The village of Michigamme shows signs of increased activity. Many repairs and improvements are being made which were greatly needed; also some new stores and houses are building, showing an increase of confidence and business. This revival is doubtless due to the large amount of exploring that is doing in this vicinity to the west of Lake Michigamme, stimulated by the

important success which has been met with in the instances recently cited, to wit: the Farm, Webster, etc.

At the Michigamme Mine, too, the owners have more reason to congratulate themselves upon increased evidences of prosperity than have been observable for some years. At both ends of the mine have important facts been elicited that tend greatly to enhance the prospects of the mine.

It will be remembered by those who are familiar with the mine, that at the west end of No. 4 pit, from the surface down, was a "header." All the levels in this pit terminated at this wall; the ore was cut square off.

Lately a diamond drill has been worked at this level, in the sixth level, 425 feet down from the surface, on the lay, and five holes have been bored from the same center, starting from the west and coming around to the north, forming a quadrant, of which the holes are the radii.

The first hole was to the west 125 feet, all in quartzite. They discovered then that they were in the hanging wall, which is of course quartzite. The direction was changed a little to the north, and a second hole bored, which passed through the quartzite and came into the soapstone, that in the vein lies between the quartzite and the ore; but as the extent of the drill was only 125 feet, they were obliged to pull out and start again, this time a little more to the north. This hole proved to be 100 feet in quartzite, ending in 142 feet No. 1 ore. No. 4 hole, still further to the north, made 100 feet of quartzite and 14½ feet No. 1 ore, and ended in No. 2 ore. No. 5 hole, at right angles to No. 1 and due north, proved the same as the two preceding ones. The ore found is identical with No. 4, showing that this, the most important pit of the mine, really continues west; that it is not pinched out or cut off, but simply thrown to the north. A drift is following No. 3 hole to reach this body of ore. This drift is already nearly through the quartzite, and in a few days will reach the deposit. The ore will be mined out and trammed to No. 4 shaft; though, ultimately, if the deposit proves extensive, it will be mined from No. 5 shaft and be reached, as now from No. 4, by cross cuts.

This discovery, if it turns out to be what seems probable it may, will greatly increase the production of the mine, adding a new and important pit.

At the east end, in the Barnum shaft, the ground has been, all the way down, very much broken up; no true walls. Instead of the quartzite hanging it has been mainly jasper, foot and hanging, and jasper in the vein, so that the ore has been in irregular pockets.

The pit down has been worked out a length of 120 feet, and to a sufficient width for the shaft; but at the bottom, 200 feet down, the vein has suddenly widened out, showing a floor of ore 12 feet wide and 25 feet long. The length has not been determined; 25 feet is the extent of the opening. It has the appearance of coming into more settled ground, and of opening into a deposit like No. 4. The ore is very similar to that of No. 4. Altogether, this pit, which has heretofore been a disappointment, has now a very encouraging look.

No. 2 pit, 600 feet east from No. 4, is looking well. The shaft is 200 feet down. This pit also has been troublesome from not having the true hanging wall; it is more settled now. The green rock, chloritic schist, has come in the right place. In all the levels, thus far opened, the vein for a distance of 50 feet west from the shaft runs narrow, when suddenly it makes a recess square off into the foot wall, of 10 feet deep and 32 feet long, when it comes back again and continues on west with its former width. The pit is 250 feet long east and west and is terminated at the east end by a bar of rock; this will be

tested with a diamond drill, as has been done in the west end of No. 4. The main stope is in the west end, where it is 40 feet high and 10 or 12 feet wide. In this end they have the regular hanging wall, quartzite with intervening soap rock between it and the ore; but as heretofore the main dependence of the mine is No. 4. Two lifts have been sunk within the year, one of 50 feet and one of 40 feet, and the skip road taken down to the bottom, making the depth of the shaft, on the lay of the formation, 60° dip, 520 feet. The ore is very clean, black, magnetic, and slate, specular ore. The vein is very uniform, having a width, from foot to hanging, of about 20 feet. The stoping is at present mainly in the seventh level. It is now the aim to have one level, all the time, ahead of the stoping. The method pursued is, after leaving the pillars to support the shaft, to drift along the hanging wall half the depth of the sink, 20 feet, and half the width of the vein, 10 feet, hoisting the ore to the cars on the track in the level above, in buckets, by means of a rope wound, with a small engine. They have three of these little puffers, which are as portable as a windlass and a hundred times more effective; they can be set in the mine wherever needed, and do the work of hoisting on stopes and in winzes most admirably. They are coming into use in many of the mines, and are found to be an important adjunct in the prosecution of underground mining work, entirely supplanting the laborious and old time windlass.

Arches are left as frequently as are needed, depending on the character of the hanging, and the track above, in making this first cut, is not disturbed. After the first drift, 20 feet by 10 feet, has been carried forward a sufficient distance, the remaining 10 feet of the vein to the foot wall is removed, and the track is supported on timbers laid from pillar to pillar. Subsequently the next lower half of the level is taken out in the same manner with the exception that instead of hoisting the ore to the track above, it is dropped to the bottom of the level below, and then trammed to the skip.

This sinking for stopes is carried on at several points at once, as they can be by the use of the little engine hoisters, and those different places are finally connected. This pit has a length east, of 260 feet, and west from the shaft of 250 feet, making its length upwards of 500 feet. It yields fully two-thirds of the product of the mine.

When the new discovery to the west is opened and its product added, and if Nos. 1 and 2 continue to improve and become, what they seem likely to do, well settled, productive pits, the Michigamme will have advanced its position into line with the first-class producing mines. A hole is now boring with the diamond drill across the formation under No. 6 shaft, to the west of the mine. It is on an angle of 55°, and is down 230 feet; is in quartzite, and will be continued until the ore is reached.

The officers and the local management remain as heretofore. Hon. W. H. Barnum, President, Lime Rock, Conn.; James Rood, Secretary and Treasurer, Chicago, Ill.; J. C. Fowle, Superintendent, Michigamme, Mich.; J. P. Christopher, Mining Captain.

The product of the mine for the year 1881 was 57,272 tons, and the aggregate product to date since 1873 is 443,274 tons.

#### THE SPURR MINE.—(JUNE, 1882).

The Spurr Mine seems to be doomed to misfortune. No mine was ever started with better prospects, and even now no one seems to have lost faith in the mine. After some years of idleness work at the mine was resumed by a



new company composed of Detroit gentlemen. The work of pumping out the water was begun May 12, 1881, and was completed in about three weeks' time.

Some new machinery was added, which included an Ingersoll, single compressor, 14x28 inches, and six air drills; new pumping machinery, consisting of 6-inch plunger pump, and one new boiler. An enlargement to the engine house was made, 12 foot extension; also a new ore dock 100 feet by 60 feet has been built, and the houses and other buildings have been put in repair. A large sump made in the mine, 28 feet by 12 feet, and 9 feet deep. In the mine a 60-foot level was sunk below the old workings, and fitted up and put into working order.

No. 2 shaft. This shaft is now down 300 feet, and they are sinking another lift, which will make the depth 340 feet. The level which was sunk has been worked out, but it is found that the vein has gone off into the hanging wall. They cross-cutted 15 feet and found it. They have commenced above to take down the wall so as to open a chamber into this lens. This new vein to the south is about 10 feet wide, and they are drifting along the hanging wall in it to learn somewhat of its extent. In this point, in the old level and in the new lens, to the south, they are working five air drills, but are not getting much ore. The stopes are limited; the work is mainly exploratory.

No. 2 is the only shaft in condition to use; the others have not been repaired. No. 1 shaft, if in order, could be used to advantage. They have drifted from No. 2 under No. 1, and could rise up to the shaft and thus work No. 1 pit, which is not as deep as No. 2 into 100 feet.

No. 1, by the old company, was thought to be worked out, but the drift below, from No. 2, is in ore, so that No. 1, if sunk deeper, would be a productive pit.

One would think that the company would put a diamond drill to work in the bottom of the mine and bore through the hanging and the foot wall, and thus learn if they have something or nothing. There is no so economical or expeditious a way of testing an iron mine in such a formation as at the Spurr, as with the diamond drill.

The situation is a very pleasant one. There is a large number of good houses and other buildings, and the machinery and other plant is adequate to a large working mine. There are four winding drums, 5 feet diameter, only one of which is used. The Spurr Mine is worth testing, and the diamond drill is the instrument to do it with.

The general office is in Detroit, Mich. H. C. Pulling, President; W. D. Wisson, Secretary and Treasurer; W. D. Davis, Local Agent; Edwin Richards, Mining Captain.

The description of the land owned by the company is the N.  $\frac{1}{2}$  of the S. W.  $\frac{1}{4}$ , and the S.  $\frac{1}{2}$  of the N. W.  $\frac{1}{4}$  of Sec. 24, T. 48, R. 30.

The product for 1881 was 2,746 tons, and the aggregate to date is 146,612 tons.

#### THE IRON KING.

West of the Spurr Mine, on section 23, the Stewart, it was formerly called, but now designated as the Iron King. Some exploring work is doing with a diamond drill, and, it is claimed, with encouraging results.

#### THE MAGNETIC MINE.

At the Magnetic Mine, section 20, T. 47, R. 30, some systematic exploration



has been undertaken with the diamond drill, and is still being prosecuted; nothing of value has yet been discovered.

#### EAST CHAMPION MINE.—(JUNE, 1882).

The Keystone Mine, which began to be worked in 1872, and has since been worked off and on, generally idle a portion of each year, has recently come out under a new name and a new organization. It is now known as the East Champion Mine. About a year ago Messrs. Spear and Case began to explore the mine with a diamond drill, and after several months working the results were so far satisfactory that a company, under the title of the East Champion Iron Company, was formed. The incorporators were Messrs. A. Kidder, James Pascoe, J. R. Case, F. B. Spear, and R. P. Travers.

Mining work was only begun in May, 1882. Previous to this, through the winter, the work was only exploratory with the diamond drill, boring from the bottom of the mine in No. 3 shaft, which is the main shaft of the mine. The result was not encouraging; at least no great amount of ore was found in the holes from this shaft.

No. 3 pit has been pumped free of water, and the shaft repaired and put in order for hoisting. The pit is 250 feet deep, and dips to the south with a quartzite hanging wall and a jasper foot. The vein in this pit is about 7 feet wide and has been opened to a distance, in the lower level, of 40 or 50 feet. The ore is No. 1 specular, similar, or nearly identical with that of the Champion Mine. They have one stope 25 feet high and the width of the vein, and have just begun to mine and hoist ore, and have also begun to sink another level. No. 2 pit is 300 feet east from No. 3. This pit has also been unwatered, and is working. It is about 100 feet deep, underground, and they are working in the bottom, where it has been opened a distance of 60 feet; the vein is from 5 feet to 12 feet wide, black magnetic ore; from this pit they are now hoisting about 30 tons per day, but when No. 3 is in full working condition they expect to hoist from the two pits 60 tons daily. A force of about 60 men is employed.

The description of the land is the S. E.  $\frac{1}{4}$  of the S. W.  $\frac{1}{4}$  Sec. 32, T. 48, R. 29, joining the Champion Mine on the east, but about one-half mile south of the railroad station, and 100 feet above it. The station is distant by rail from Escanaba, 77 miles, and from L'Anse 35 miles; from Marquette, 29 miles.

The officers are: Frank B. Spear, President; S. Watkins, Secretary, Marquette; J. G. Reynolds, Treasurer; C. T. Hampton, Agent.

The product for 1881 was 3,408 tons, and the aggregate to date is 64,264 tons.

#### THE TAYLOR IRON COMPANY.

Further to the west, seven miles east of L'Anse, is the Taylor Mine. It is the only point where a deposit of ore has been worked in this range, so far to the north. The mine is near the center of the N. E.  $\frac{1}{4}$  of the N. W.  $\frac{1}{4}$  of Sec. 9, T. 49, R. 33. The location is 950 feet above Lake Superior; is high, dry ground, with ample slope for drainage. The ore at this mine is a soft hematite, similar to that obtained from the Mitchell, etc.

Analyses of the ore show a percentage of metallic iron from 55 % to 60 %, and about  $2\frac{1}{2}$  % in silica and 0.15 % in phosphorus. The land is owned by the M., H. & O. R. R. Co., and is leased to this mining company, which company

was organized in 1880, holding a quarter of a section of land, the N. W.  $\frac{1}{4}$  of Sec. 9. Mining work has since been pursued, resulting in an aggregate shipment of ore of 10,559 tons, 9,499 of which were the product of 1881.

The mining work is now underground. It was first undertaken in an open cut, but subsequently a vertical shaft was sunk 140 feet to the west, to a depth of 128 feet. From the bottom of this shaft a large chamber has been worked out, 115 feet east and west, and 58 feet north and south, in which the roof is supported by four large pillars.

At the west end are three drifts to the west, in each of which is a stope of ore. In the south drift the stope is about 12 feet high and the same width; in the others they are 10 feet. On the north side they have a small stope rising on the foot wall. In the bottom they are sinking for another stope. To the west, 50 feet from the mine, they are sinking a vertical shaft, which is down to a depth of 140 feet. From this shaft the mine will be worked to the west.

The company had this spring, in stock pile, 5,500 tons of ore. A small plant of hoisting machinery is now being supplied; two internal friction gear drums, 30-inch diameter.

The officers are; S. G. Mather, President; Samuel Mather, Secretary and Treasurer, Cleveland, Ohio; H. E. Warner, Agent; John Skoburg, Mining Captain.

#### THE CHESHIRE MINE.

The Cheshire Mine, formerly the Silas C. Smith Mine, is located in the S. E.  $\frac{1}{4}$  of Sec. 18, T. 45, R. 25; was opened in 1872, and has yielded an aggregate of 87,179 tons of ore. The ore is a soft specular, and a soft, bronze colored, putty like ore, yielding about 60 % in metallic iron and about .04 % in phosphorus. A branch railroad five miles in length connects the mine with the Chicago & Northwestern road.

The mine has not afforded a very promising outlook of late, and is at present being worked to a very limited extent. The same parties owning the Cheshire having found a far more productive mine on an adjacent forty, have transferred their operations to this new location, now called the Swanzey.

#### THE SWANZEY.

This mine is situated on the S. W.  $\frac{1}{4}$  of the N. E.  $\frac{1}{4}$  Sec. 18, T. 45, R. 25. This mine is about 1,500 feet distant to the northwest from the old workings. It consists of an open pit 200 feet long, about 40 feet wide, all in ore. It is worked to a depth of 70 feet. In the west end of the pit is a fine stope of clean ore, 50 feet wide, and as the bottom is ore they can of course sink for new stope at will. The direction of the ore deposit is northwest, and the dip 60° northeast. The hanging wall, a so-called slate, and the foot wall a mixed ore and jasper. The estimated product for the year is 30,000 tons. The following is an analysis of the ore.:

Oxide of iron.....	95.28
Alumina.....	1.35
Lime.....	.60
Magnesia.....	.35
Sulphur.....	.02
Phosphoric acid.....	.31
Silica.....	2.06
<hr/>	
Metallic iron.....	66.70
Phosphorus.....	0.135

Showing it to be too high in phosphorus for the making of Bessemer steel, but rich in metallic iron. The phosphorus, however, varies greatly, some analyses being as low as .040. At present the hoisting is with drum and derrick, but a new plant of machinery will soon be provided. A side track from the C. & N. W. branch comes into the mine, and on it are the ore dock, pockets, etc., for conveniently transferring the ore.

Some renewed attention is to be given to the old mine; it is now being freed of water.

The President is Mr. J. J. Pierce, Sharpsville, Pa.; Agent, J. F. Stevens, Negaunee, Mich.; Superintendent, A. P. Wood.

Product 1881, 7,562 tons.

## MENOMINEE IRON RANGE—(JULY, 1882).

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The first shipments of ore from this range by rail were made in 1877, and so rapid has been the development that the aggregate shipments in 1881 from the mines on this range amounted to 739,108 gross tons of ore,—certainly a most extraordinary result to be accomplished within the brief period of five years.

The ores obtained in this district are all hematite and soft specular, but generally of an excellent quality; and some of the largest mines, as the Chapin, Vulcan, etc., yield a product which is nearly as valuable as the best hard specular ores of Marquette county, being high in metallic iron and sufficiently low in phosphorus for the manufacture of Bessemer steel.

Some of the mines, among the largest producers, are south of the Michigan line, and are thus in the State of Wisconsin. The largest of the mines on the Menominee Range, outside the limits of the State, are the Commonwealth and the Florence. The best ores that have thus far been found are in Michigan.

Many discoveries have been recently made, and everywhere men are searching and exploring for ore. Several new iron districts are soon to be opened in a range lying north of the one through which the present railroad extends. Branch railroads are building to these localities, and at each considerable activity prevails. They are known as the Felch Mountain, the Iron River, and the Crystal Falls districts.

The Crystal Falls, or Paint River district, is the most largely developed of any of the new mining localities in the Menominee Range. It has been recently made accessible by the northwesterly extension of the railroad from Florence seventeen miles, and the work of building branches to the several mining locations in this vicinity is actively in progress. The railroad was completed in April last (1882), at the terminus (Sec. 21, T. 43, R. 32). The village of Crystal Falls has been surveyed and platted, and the building of houses, stores, etc., is pushed with all vigor, so that the plot is promising to attain, in a brief period, to a town of considerable size. Building has been greatly facilitated through the operation of a saw mill, with planer, etc., that has furnished the lumber. The mill is driven to the limit of its capacity and is scarcely able to keep up with the demand. In the region of Crystal Falls is a fine timber country,—maple, basswood, pine, fir, etc.,—not surpassed by any portion of the State. The pine, however, is the only timber now used in building. The ore thus far found in this vicinity is all low grade, 50 % to 58 % in metallic iron, and too high in phosphorus for steel-making purposes, and containing also a pretty large percentage of lime. The deposits are also, generally, far from affording clean ore. They are mixed rock and ore, and the product of the mines, to all appearances, as thus far developed, will need to be carefully sorted to obtain merchantable ore.



## THE YOUNGSTOWN IRON MINING COMPANY.

The most important of the mines in this vicinity is found in the N.  $\frac{1}{2}$  of the S. E.  $\frac{1}{4}$  of Sec. 19, T. 43, R. 32, worked and held in lease by the Youngstown Iron Mining Company. The ore deposit runs east and west across the company's land, and has been sunk to in pits, which extend for half a mile. The mine openings are in a cedar swamp leading to the north, and to the east and west, but south the land rises in a long slope, which extends indefinitely east and west. The company holds also the adjoining lands on the east, to wit: the W.  $\frac{1}{2}$  of S. W.  $\frac{1}{4}$  of Sec. 20, also the S. E.  $\frac{1}{4}$  of the S. W.  $\frac{1}{4}$  of Sec. 20, making in all 200 acres.

A test was made with the diamond drill across the ore in the land on Sec. 19. The boring was made to the south at an angle of  $45^{\circ}$  with the horizon, the drill passing through 105 feet of ore, having started in ore, and 38 feet of rock. The drill was then turned to the north, made to penetrate at the same angle, and passed through  $7\frac{1}{2}$  feet of the same ore and 150 feet of soft jasper, then 149 feet of ore terminating in bluish slate. The drill was worked from the same station in boring both holes. It will thus be seen that there are two deposits of ore separated by 100 feet of rock. The north body is a dark, rather bluish ore. The south deposit a much softer, brownish ore, wholly free from silicious rock, but contains lime. The small stock pile, obtained from the new shaft, is all ore, but apparently not high in iron. In this deposit a large double shaft is now sinking, having attained a depth of 50 feet, and is timbered and lined up in good shape; the bottom is in ore, with no mixture of rock. Two other shafts are also going down, one to the east and one west; one of them, the west one, is now in ore. North of these shafts, on the north vein, the earth is being removed over a sufficient extent for a large pit, which will be worked openly. This stripping is about 10 feet in thickness; on the south vein it is much greater, and this mine will be worked underground. The railroad from Crystal Falls village has been graded to the mine. The iron is now being laid and the track ballasted, and in a few days from this date (July 1), the road will be ready for operation. A slope of one in a hundred has been given to the track, sufficient, it is deemed, to allow the cars to run down to the east. The empty cars will be backed up to the west end of the mine and left, by the locomotive, and then run down as required to the pockets and ore docks, and thence to the yard beyond, to the east, by the force of gravity alone. Sufficient exploration has been done to establish the fact that the company has here ore enough for making a large mine, but it is questionable if it is of a quality to be salable in dull times.

Upon the hill south of the mine the company has built a large boarding house, and other dwellings have been erected, or are in process of being constructed.

There is a good deal to be done to open a mine in the wilderness and get it into successful operation, but the company is at least fortunate in having the services of Mr. F. P. Mills in this difficult undertaking; a young man, energetic, clear headed, and experienced in the business, Mr. Mills has, for his age, few equals and no superiors among mining superintendents in the district. He is making everything tell, and is sure to have matters in good shape. The organization of the company was completed June 15, 1882. The officers are: John Stambaugh, President, Briar Hill, Ohio; J. V. Butler, Vice President; Henry Todd, Treasurer; Henry Stambaugh, Secretary; J. G. Butler,

General Manager: office, Youngstown, Ohio; F. P. Mills, Superintendent, Crystal Falls, Mich.

Butler Creek, a small stream a few rods north of the mine, will afford excellent water for the boilers.

#### THE CRYSTAL FALLS MINE.

This mine comprises Lot 3, Sec. 20, T. 43, R. 32, being about fifty-three acres of land, and being bounded along the northeast side by the Paint River.

The Paint River Falls, or Rapids, Crystal Falls they are called, make here, in the center of Sec. 20, in a distance along the stream of 800 feet, a descent of 17 feet. At the lower end of the rapids, on the right bank of the river, looking downward, is an outcrop of lean ore, noted by the United States surveyors. In this outcrop, near the bank of the stream, a shaft has been sunk to a depth of 94 feet, and is now being timbered and put into shape for hoisting. The vein, thus far, is narrow, scarcely wider than the shaft, but it is intended to push it down and to drift, hoping that the deposit will increase in dimensions. This shaft affords some extraordinary good ore; very heavy, fine specimens are found in the stock pile, but these are far above the average. There is also considerable rock, and the stock pile, consisting of about 1,500 tons, will have to be picked over carefully before shipping. The mine is about midway between the Youngstown, Sec. 19 mine, and Crystal Falls village. At this point the river is spanned by a common highway bridge, and a few rods above it a railroad bridge is being constructed to carry the track from the main branch, by means of a "weye," over the river to the Fairbanks, Paint River, and Great Western Mines. It is very doubtful if the work on this river shaft results in anything of much value. There is but a short stretch of ground between to the center of the stream, which is the boundary line, and the ore deposit, so far as it has any inclination, is in that direction. Southwest from the shaft, 500 or 600 feet distant, a diamond drill is at work boring to the south at an angle of 60° inclination, and came into ore at a depth of 182 feet. The drill has gone through 100 feet of ore, being still in it. The core is an ocherous, reddish, yellow hematite, of probably about 50 % of iron. It has not yet been analyzed. There is evidently a large body of it, and if it proves to be sufficiently valuable a mine will be opened. In the vicinity of this boring, between it and the river shaft, a number of dwellings has been built for the occupation of miners.

This mine, Lot 3, was lately purchased by the Crystal Falls and the Youngstown Iron Companies, and it is now owned and worked in common by these two companies. The price paid is given out as \$80,000, which seems to be a large sum considering the showing of ore; but it is said that a good deal of the value was based upon the water power at the rapids. The Paint River has a large volume of water, and the power at this point may be utilized to operate a large air compressing plant, sufficient for the hoisting, pumping, and air drill purposes of all the mines worked by the two companies, in this vicinity. The railroad has been completed west beyond the mine, and a switch and side track laid to the stock pile, so that the ore on hand will soon be sent away. The work is under the superintendence of Mr. F. P. Mills, and the other general officers of the company are: W. K. Fairbanks, President; J. H. Howe, Vice President; F. H. Head, Secretary and Treasurer.

The Crystal Falls Iron Mining Company also, in addition to the mine above described, owns and operates

#### THE FAIRBANKS MINE,

Which is situated on the west side of the S. W.  $\frac{1}{4}$  of Sec. 21, T. 43, R. 32. The section line, north and south, cuts through the mine openings, half way from the section corner south on the Paint River, and the quarter post north. At this quarter post is the railroad grade, which connects with the main branch, half a mile west, and extends east half a mile, coming back west to the mines on a "wye." The railroad is made long and expensive, to avoid heavy grade, and the Northwestern Railway Company is certainly very liberal to undertake so large an expenditure, based upon so poor a showing of ore. The mine is simply an open cut 150 feet in length east and west, 40 feet in width, and 50 feet in depth. The vein is a mixed ore and rock, but little of the vein is clean ore, so far as yet opened. The stock pile, which consists of several thousand tons, will require careful picking over to secure from it merchantable ore. In quality it is an "off" ore, about 55 % iron, and high in phosphorus. The company is sinking at the west end of the cut to take out the bottom, and is also stripping at the east. It is claimed that the test pits to the east are bottomed in ore, showing the existence of a large body of it. If the ore were cleaner and of a little better quality the prospect would be extremely good. As it is, accepting the quality as a merchantable ore, the showing, for the amount of work done, is a hopeful one to the owners, and certainly affords a basis for a reasonable expectation of paying results.

There is a substantial engine house, north of the mine, occupied by two 3-foot drums, and two small engines, etc., operating the two hoisting derricks. To the south are the boarding house and dwellings.

The Superintendent of the Fairbanks Mine is Mr. J. H. Elmore, who resides at Crystal Falls. The immediate supervision of the mining work is under the direction of Capt. Morrison.

The Crystal Falls Company, in addition to these two mines, laid out the village, and also owns and operates the saw mill, etc.

#### THE PAINT RIVER MINE.

Adjoining the Fairbanks Mine on the west is the Paint River Mine. The property comprises the E.  $\frac{1}{2}$  of the S. E.  $\frac{1}{4}$  of Sec. 20, owned by Ed. Breitung, Esq., of Negaunee, but held under a lease and operated by the Paint River Iron Company. A portion of the mine is the west end of the Fairbanks open cut. The surface is being still further stripped to the west, preparatory to continuing the open cut mining in that direction. For a considerable distance to the west test pits have been sunk, and two shafts are sinking in the line of the deposit, both of which are now in ore. The ore is identical with that found in the Fairbanks. A hoisting plant is being set up, and there is every prospect that the company will soon be making a stock pile of ore. The work is in charge of Capt. C. Y. Roberts, formerly Superintendent of the McComber Mine at Negaunee. The other officers are Max Wineman, President, Chicago, Ill.; Joseph Austrian, Secretary and Treasurer, Chicago, Ill., who, with Messrs. Ed. Breitung, John McKenna and Dr. Bond, form the Board of Directors.



## ANNUAL REPORT OF THE THE GREAT WESTERN MINE.

East from the Fairbanks and Paint River Mines is a new location known as the Great Western Mine. The mine is in Sec. 21, T. 43, R. 32, the company holding on a lease the southeast quarter.

The company is sinking two shafts, which have as yet reached but little depth. From the west one a lean mixed ore is being hoisted, which is sorted over, and a stock pile has been begun. The east shaft is also down to the ore, and the miners claim that in this shaft it is cleaner and of better quality, but not enough has been done to justify the expression of an opinion regarding the prospects for a mine. The branch railroad that runs into the Fairbanks, etc., comes also to the Great Western.

The officers are: S. C. Hall, President; J. M. Case, Vice President; S. D. Hollister, Secretary; George Runkle, General Superintendent, Crystal Falls, Mich.

## THE UNION MINE.

The mine having the largest stock pile of any of the new openings in this vicinity is the Shelden and Schafer, situated about three miles southwest from Crystal Falls. The estate of R. Shelden and Mr. J. F. Schafer own the land, and have leased it to the Union Iron and Steel Company, of Chicago, and the mine is now known as the Union Mine. The estate comprises the N.  $\frac{1}{2}$  of the N. W.  $\frac{1}{4}$  of Sec. 31, T. 43, R. 32.

Mining work has been in progress here for about a year, and ore, estimated at 10,000 tons, has been taken out and put into stock pile awaiting the completion of the railroad for shipment. This ore is mixed with rock, and will require considerable sorting when transferred to the cars. It is claimed that it is lower in phosphorus than that obtained at the other mines in this neighborhood. The open cut, from which it has been taken, is about 150 feet in length, east and west, and 40 feet in width, and 50 feet in depth. The sides are vertical, but the dip is probably to the south at a steep angle. The foot wall side is a smooth, silicious schist, and the hanging similar, but more broken up and showing more jasper, into which the ore appears to extend, as a short drift into the hanging shows seams of ore and rock mixed up pretty freely. The bottom is ore, as are also the ends of the cut, but no part of it seems to be wholly free of rock. The hoisting is done with derricks and buckets worked with a steam engine. The railroad is graded to the mine nearly ready for the iron, from Crystal Falls Village. The work is prosecuted under the supervision of Capt. Bortle, and the company's agent is Mr. W. H. Waters.

## THE MANHATTAN IRON COMPANY.

The Manhattan Iron Company is organized to work the N. E.  $\frac{1}{4}$  of the S. E.  $\frac{1}{4}$  of Sec. 13, T. 42, R. 33. The company holds the land under a lease from T. B. Brooks and S. L. Smith, and explorations are in progress to find a deposit of ore of sufficient magnitude to constitute a mine, the attempt being, apparently, instigated by the favorable results obtained at the adjoining location, the Mastodon.

The officers are: Ed. Breitung, President, Negaunee, Mich.; J. H. Outhwaite, Secretary and Treasurer.



## THE MASTODON MINE.

As previously stated adjoining the above described location is the Mastodon Mine, comprising the S. E.  $\frac{1}{4}$  of the N. E.  $\frac{1}{4}$  of Sec. 13, T. 42, R. 33, held under a lease by the Mastodon Iron Company, which organization is now prosecuting the mining work, under the superintendence of Capt. Richard Pocklington.

The officers are: Ed. Breitung, President, Negaunee; Joseph Austrian, Secretary and Treasurer, Chicago, Ill. Mining work was begun in an outcrop that protruded above the surface of the surrounding swamp, and from this opening some 1,500 tons of ore have been taken out and put into stock pile. A short distance to the west a shaft is down 50 feet, and bottomed in ore, and a second shaft, 100 feet further to the west, is also sinking. The ore is, apparently, a very good quality of hematite, free of rocky mixture, and thus affords very favorable indications to stimulate further investigation. Some diamond drill work has been done with, it is stated, a favorable result.

The development of this new mining district has been greatly accelerated through the enterprise of the

## CHICAGO AND NORTHWESTERN RAILWAY COMPANY,

Which company, with extraordinary liberality, considering the limited amount of exploring work that had been done, has extended its line to this region, and is building branches to all the mining locations.

The same may be stated regarding all the mines on the Menominee Range. The Northwestern Railway Company has never hesitated to secure to every new mine, as speedily as possible, a branch railroad, thus enabling these incipient enterprises to begin the shipment of ore almost with the advent of their mining operations, and thereby, through the sale of the product, securing the funds to open the mine.

Without the aid and co-operation of this great corporation the iron mines must of necessity have been slow of development, and the Menominee Iron Range, instead of its busy, thriving villages, the wonderful activity everywhere manifest, its numerous mines, now reaching, in 1882, an aggregate yearly output of, probably, 1,000,000 tons of ore, would have yet remained an unbroken wilderness.

The discoveries of iron ore which have been made in what is called the Iron River District seem likely to become the most important of any recently made known. This region is in T. 43, R. 35, in the vicinity of Iron River, being the same distance north as the Crystal Falls district, and three townships west. The main line of the Menominee division of the Chicago & Northwestern Railway is building northwesterly to this point, from what is called the Iron River Junction, the point where the railroad turns north to Crystal Falls. The distance is about fifteen miles. The Iron River runs southerly and empties into the Brulé. Two villages have been platted in the southeast corner of the township, situated upon the east bank of the river, about two miles apart, to be called, the one Iron River, and the other Stambaugh.

## IRON RIVER MINE.

Of the mines which have been opened in this vicinity the one attracting the largest share of public attention, and which shows at the present time the

greatest amount of ore, is the Iron River Mine, controlled by Mr. John Stambaugh, the President of the company, who is also President of the Youngstown Iron Company. The Iron River Mining Company holds, under a lease, the W.  $\frac{1}{2}$  of the S. W.  $\frac{1}{4}$  of Sec. 36, and the E.  $\frac{1}{2}$  of the N. E.  $\frac{1}{4}$  of Sec. 35. The mine openings, which are in Sec. 36, show a very large body of ore, perhaps 100 feet and upwards in width, which has been traced for upwards of a mile in length. Sufficient work has been done on the location to establish the certainty of the existence of a large body of shipping ore on the property, and it may become one of the most considerable mines in the State. The ore is said to average about 60 % in metallic iron; to be free from lime and low in silica, but as yet showing too much phosphorus for Bessemer.

The officers of the company are: John Stambaugh, President, Youngstown, Ohio; George Boyce, Vice President; R. McCurdy, Secretary and Treasurer; J. P. Jones, General Agent, Florence, Mich.; James N. Porter, Superintendent, Iron River, Mich.

The mine openings are at a considerable elevation, affording great advantage in opening the mine, and for cheaply handling the ore.

#### THE NANAIMO MINE.

The Nanaimo Mine is in the W.  $\frac{1}{2}$  of the S. W.  $\frac{1}{4}$  of Sec. 26, T. 43, R. 35, being northwest from the Iron River Mine a distance of about two miles. The work done here has discovered the ore deposit in magnitude equal to that shown at the Iron River location, and the ore is entirely similar. The mine is on the west side of the river, and in comparatively wet ground. Preparations are rapidly being made for mining and shipping a large amount of ore as soon as the railroad shall be completed to the mine. The village of Iron Mountain, in the vicinity of this mine, is rapidly growing.

The officers are: John S. McDonald, President and Treasurer; John Spencer, Secretary. The work is under the supervision of Thomas Luxmore, Superintendent. The land is owned by D. C. McKinnon.

#### THE CHAPIN MINE.

The Chapin Mine is one of the wonders of this remarkable country. Its history affords no parallel. For a mine not yet three years old it has probably never had an equal among iron mines, anywhere in the world. Making its first shipment in 1880, of 34,556 tons, it increased in 1881 to 134,521 tons, and in 1882 its output will reach, it is estimated, 250,000 tons. Already to July 1st 100,000 tons have been shipped, and 40,000 tons yet remain in the stock pile, and they are mining and hoisting at the present time an average of 900 tons per day, and the entire product is a single grade,—uniform, first-class ore. A curious feature in the history of this mine is the fact that the owner, Mr. Chapin, of Niles, Mich., held only one ticket in the lottery; he possessed only this land, these forty-acre lots, and it has proved to be the prize. In 1872 Mr. Chapin wrote to me for information regarding this land; of the probability of its containing iron ore, etc.; all that could be said of it then was necessarily the merest conjecture. It was in the iron range, deeply covered with drift; few persons had ever been anywhere in the vicinity, and still fewer had ever seen this particular land. A year subsequently, in 1873, a good quality of red chalk ore was discovered by Mr. Hyde, on land near the Chapin, and thenceforward this locality was thought to have a value.

The land, comprising the S.  $\frac{1}{2}$  of the S. W.  $\frac{1}{4}$  and the S. W.  $\frac{1}{4}$  of the S. E.  $\frac{1}{4}$  of Sec. 30, T. 40, R. 30, is leased to the

#### MENOMINEE MINING COMPANY,

Which organization opened and operates the mine, paying a royalty to the owner, per ton, for the ore mined. The company also holds adjacent lands to the west, extending for a mile or upwards. The mine begins near the north-east corner of the Chapin land, and runs northwesterly for a distance of half a mile, or across two of the forties, and the company is now beginning to open on the west forty, a shaft having been recently begun close to the west line, adjoining the Ludington Mine.

There are ten shafts in all, numbered from the east to the west. Seven of these are working shafts, or soon will be used in hoisting ore. They extend along the northwesterly slope of the hill, the surface rise from the west to the east end of the mine being about 100 feet. These shafts are all sunk to the bottom level,—to the second level, it is called, being to the same depth below datum. The shafts descend to the north at an angle of 70° to 85°. They were intended to be sunk against the foot wall, but the ore is so deeply covered with drift that this was not always accomplished, and the shafts, in several instances, are some distance away from the foot toward the hanging. The others, the three remaining shafts, are used for taking down timber into the mine, so that no interference is allowed in the hoisting.

All the shafts are large and very substantially lined up; in this respect no better ones are to be found anywhere in the country. They are provided with skip roads. Some of them are furnished with double skip tracks. The depth of the shafts at the east end is about 300 feet below the surface, and at the west end, owing to the descent in the surface of the ground, the depth is, to the same level, 200 feet. The shafts are worked from the two engine houses, in the west one of which are six. Lane hoisting drums, 5 feet each diameter, and in the east building there are three of these drums; also three 30-inch drums for operating the timber shafts. In addition, in the west engine house, is the electric light engine, 16x36 inches. The main engine is 24x48 inches, Milwaukee manufacture. In the east building are two Corliss engines, each 16x42 inches, and the company is now putting in two 16-inch plunger pumps. The machinery for these pumps is deemed of sufficient power for a depth of 1,000 to 1,500 feet. These pumps will be placed in the new west shaft.

The ore from the shafts, when hoisted from the mine, is run out on long, elevated tracks, at the extremity of each of which are the ore pockets, beneath which are the railroad side tracks. The ore is, of course, during the season of shipping, dumped into the pockets, and thence dropped directly into the cars, otherwise, in the winter, etc., it is dumped over the side of the trestle and lies in stock until wanted for shipment.

The elevated track on which the ore from the three east shafts is run out to the pockets, is 800 feet in length and 64 feet in height, at the west end. This trestle is laid with double track and is worked with wire rope—Frue's automatic elevated railway. The run is made out and back in three minutes, the car carrying two and a half tons of ore. The other tracks are shorter and of less height, and the tramming is done by hand.

A new No. 1 shaft at the east end of the mine has just reached the ore,—July 2d—having passed through 50 feet of drift and a few feet of cap rock.



The shaft has a slight inclination to the north,  $85^{\circ}$  from the horizontal; the ore found is the best—soft, blue specular, free from mixture.

Descending No. 3 shaft to the second level, a cross cut was made to the north, 50 feet in rock, coming to ore, through which they drifted 80 feet across. This cross cut is at the bottom, second level, 200 feet below the collar of the shaft, and 100 feet west from it. West from No. 3 shaft the ore deposit becomes of great width. The vein is split into a north and a south deposit. The latter is opened through the whole length of the mine, but the north vein has in this pit a drift across the ore 100 feet, without reaching the hanging wall. The south vein is here, and for a considerable distance to the west, about 15 feet wide, but attains, in No. 8, a width of 130 feet.

The ore is taken out in chambers, 20 feet wide, leaving pillars of ore between of the same width; as the ore and slaty walls are soft and slack, and become yielding and friable on exposure to the air, the pillars and walls of the vein are lagged up with cedar poles, or slabs from the mill. The lagging is supported by the upright posts, which are set in contact with the ore pillars or rock. These posts are placed 7 feet apart, and are 7 feet in length, made with a tenon at each end and set in a mortise in a mud sill, and capped with a mortised timber that reaches from pillar to pillar, and resting on four posts.

These successive "bents," seven feet apart, running lengthwise with the vein, reach from foot to hanging wall, and are set as soon as the ore is taken out to the height of the post. When one stage is thus made the top is covered with poles, usually the bodies of small cedar or fir trees split in halves, and a floor is thus made on which the men can stand, etc., for stoping out another similar lift, the ore being allowed to pass through suitable apertures to the bottom below. Another 7-foot rise having been made, posts are set and capped, coming exactly over those below, and so on in succession, one 7-foot staging above another until the level above is reached, when the final rows of topmost posts come under the sills, and posts of the preceding level. The ore, which is broken down, is all milled down to the bottom and thence trammed to the shafts.

The chambers or openings run each way, at right angles, 20 feet wide, across and lengthwise of the vein, so that each pillar stands in the center of an opening, 20 feet wide on all sides of it. The uprights are stayed from swaying or knuckling, by the lagging, which is crowded between the outward posts and the pillars and walls. These posts and cross timbers are fitted before going into the mine, and are lowered down in the timber shafts. Heretofore these timbers have been used in the "rough," and were framed by hand, but a mill has been recently erected on the location where the logs are now all squared by the saw, and machinery has also been erected in the same mill for framing the timbers and fitting them all to the pattern required; and this important part of the work has thus been greatly cheapened and expedited the timbering in the mine. Of the 500 men employed underground in this mine, about one-third of them are engaged in the work of timbering. The mine is very roomy, airy, and apparently secure and safe. A very large proportion of the ore is left, but it is expected that in time some of the pillars will be removed, when the necessity for their presence is passed.

The shafts are sunk to the third level a depth of 100 feet below the present bottom, but the lower level has not yet been, to any considerable extent, otherwise opened; it will be attacked to furnish the next year's product, when a fourth level will be sunk.



In No. 6 shaft they have begun to drift in this lower level. The hanging wall is a dark colored schist, very similar in appearance to the ore, it being frequently difficult to distinguish the wall from the ore, by the eye; the weight and feel serve at once to designate them. After being exposed this north wall shells off and crumbles up into black dirt; it also contains some thin layers of quartz. The foot wall is similar in character to the hanging, a black slate, sometimes chloritic schist, becoming jaspery in places, but it shells off on exposure, and is lagged up to keep it in place.

No. 7 shaft was sunk off the foot wall, coming down nearer the hanging, so that the chambers are opened to the south, toward the foot; near it is a timber shaft. To the west of No. 7 the vein is 100 feet in width, widening in direction of No. 8, where it increases to 130 feet, and continues of like dimensions for 200 feet, as far as it has been proved by cross cuts, to the west.

No. 9 is a new shaft sunk vertically; it is double, and will be worked with a double cage, or one of the compartments will be used for a pump-rod and pipe. It is nearly completed, and they will soon be hoisting ore in it from the second or working level. The shaft is also to the third level, 100 feet lower down. From the top of the shaft is a new elevated track to the new ore pockets.

From the collar of No. 10 shaft to the second level is 90 feet, and an additional downward extension has been thus far made, of 50 feet. A drift extends west from it 130 feet along the foot wall. In sinking the shaft, etc., the ore is trammed along the first level, and hoisted in old No. 8. Ultimately the ore hoisted from Nos. 8, 9, and 10 will reach the pockets on the new elevated tramway. No. 10 is also a new shaft and is made double. From No. 9 shaft, west along the foot wall, are 8 or 10 feet of red ore, succeeded by the blue, soft specular. There is considerable of this rich ore in other parts of the mine, but no separation is made. While slightly inferior to the blue, it all goes together as one grade.

The bottom or third level, to which the shafts have been sunk, has not been crossed with drifts, but there is every probability that the deposit is of an equal width with what it is found to be where now worked. It is a wonderful deposit; of such an enormous width for so great length, and all of it such excellent ore, averaging 63 % in metallic iron and 5-100 % in phosphorus, admitting of the use of the entire product for Bessemer steel. The mine is all underground; no portion of it was ever worked in open pits.

It is expected that ultimately the power for operating all the machinery will be supplied by compressed air, the compressing plant to be placed at the upper Quinnisee Falls, on the Menominee River. The Menominee has a large volume of water, and at the falls a head of 40 feet may be used. The project is entirely feasible, and steps have already been taken to carry it into execution. A canal or race will be cut around the falls of sufficient depth to secure the ingress of the water, and long enough to give all the head desired. The compressed air will be brought in a 24-inch pipe, two miles, to the location.

All the important rivers in this portion of the Peninsula,—the Menominee, Sturgeon, Brulé, Paint, etc.,—afford many good water powers, which in time will be utilized in mining work, and probably in other manufacturing industries. The whole country is covered with valuable timber, pine, cedar, poplar, birdseye, lynn, birch, etc. The trees have grown to a height and size and have a thriftiness, surpassed in no portion of the State. Certainly these

forests of timber and these water powers in proximity form the basis of a variety of manufacturing industries, capable of an indefinite expansion. But I have wandered from the Chapin Mine. No matter, perhaps; it is a good thing to radiate from and to come back to. The mine is so large, and so rich and so young, that it becomes an agreeable subject to contemplate, and for the imagination to dwell upon. The pleasant village of Iron Mountain, which is the name of the station of the Northwestern Railway, and adjoins the mine, is in a very thriving condition, and gives promise of growing into a large and important town. It derives its name from the elevated outcrop of lean ore, situated to the south of the Chapin, which was known to the early explorers in this country, and became designated as Iron Mountain.

The water for the boilers at the mine is pumped from a small brook, which runs through the swamp below the bluff, across the location; a double Ringold's pump is used.

The lease of the land is owned and the mine is operated by the Menominee Iron Mining Company, whose general office is in Milwaukee. The local mine officers are: Mr. A. C. Brown, Agent; Capt. C. B. Rundle, Superintendent; Wm. M. Oliver, Mining Captain.

#### THE LUDINGTON MINE.

Next west from the Chapin is the Ludington Mine. The old mine further to the west became exhausted of ore, and the company has been at work for some time, making borings with the diamond drill to find the continuation of the Chapin vein on the Ludington land. These explorations were without avail until about February last, when the much coveted deposit was finally reached, somewhat to the north of the line in which the borings had been principally made and in the direction in which the deposit was supposed to continue. It is shown by these explorations that the ore deposit, in passing from the Chapin land into the Ludington, curves sharply to the north, making a hook. It curves to the north and dips to the north.

The new mine is very near the west line of the Chapin Mine. Mining work was begun in April last (1882) and the present outlook is exceedingly favorable. They are now mining in two open pits, and are sinking a shaft, which is also in ore. The ore is the soft, blue specular, identical with the Chapin.

The west pit is about 50 feet in diameter and 40 feet in depth. The south side is mainly rock, but the bottom and west side are of ore, as is also the north wall. Into the latter a cross cut has been driven to the hanging wall, and there is thus shown to be an apparent width of ore of 80 feet. In the east end of the pit a horse of rock protrudes from the foot wall north, partially separating this from the east pit, which latter is longer and narrower than the other, and shows a much less width of ore. There is, however, 15 or 20 feet of ore in the bottom.

The shaft, still east from No. 2 pit, is 100 feet in depth, and from the bottom they are drifting west to come under the pit, and are also drifting east and cross cutting.

In the No. 2 pit they have the hanging wall in the north side, or what appears to be such, and on the south side the rock interposes to separate the ore from its occurrence 10 feet further south. It appears as an island of rock in the midst of the ore, as the ore seems on the surface when the dirt has been removed, to make around it on all sides.

The overlying drift is 8 to 10 feet thick, and has been stripped away for some distance south and west. From the shaft to the west end of the mine they have opened the ore a distance of 500 feet. They are now taking from the mine and loading 60 cars in 24 hours, 7 tons to a car. The Northwestern track comes in east of the shaft.

The machinery comprises three five-foot drums, Rochester, and two boilers. These drums are operated by small engines placed on the same frame with the drum and on either side of it. The cylinders are 10x14 inches. There is also a machine and blacksmith shop, etc. The company employs 150 men.

The mine is owned by the Lumbermen's Mining Company. The property is S.  $\frac{1}{2}$  of the S. E.  $\frac{1}{4}$ , Sec. 25, T. 40, R. 31.

It is under the local management of Geo. E. Stockbridge, Agent. Capt. Wm. Bice, Mining Captain, Iron Mountain, Mich.

The product of the old mine in 1881 was 3,374 tons, and the total shipments to close of 1881 are 12,250 tons.

#### THE EMMETT MINING COMPANY.

The Emmett Mining Company is boring with a diamond drill a few feet from the Ludington line to the north. They are going down with a vertical hole, which has already, July 8th, reached a depth of 500 feet. It is expected, as the ore deposit dips to the north, to reach it at a depth of 700 to 900 feet. This hole is in the S. W. corner of Sec. 30, T. 40, R. 30.

#### THE HEWITT MINE.

The Hewitt Mine lies south of the Chapin. It was opened close to the Chapin south line, and as the ore dips to the north the mine was soon worked out and exhausted, the ore having passed to the Chapin side of the line, *i. e.* crossing the south line of Sec. 30, the Hewitt being in the N. W.  $\frac{1}{4}$  of the N. E.  $\frac{1}{4}$  of Sec. 31, T. 40, R. 30.

The mine has two shafts, 100 feet apart, but the ore is entirely worked out. A cross cut has been run to the south 200 feet, and has intercepted a vein, 18 feet wide, of fine blue ore, from which they are now mining. The ore is trammed out through the cross cut, and hoisted from the shaft, and reaches the cars from the pockets that are connected with the shafts by a long, elevated tram-way. In this new south vein they are sinking from the surface.

The agent of the company is Mr. C. H. Jones, Menominee, Mich. The mine produced in 1881 4,352 tons.

#### THE QUINNESEC MINE.

The Quinnesec Mine is narrowing up rapidly. The land comprises the S. E.  $\frac{1}{4}$  of Sec. 34, T. 40, R. 30, and the mine is situated upon the hill, a little way from the pleasant village of Quinnesec to the northwest. The elevation is about 120 feet above the railroad at the Northwestern depot. The strike of the vein is east and west, and the dip is to the north at an angle of about 70°. The pitch of the ore is to the west. The rock comes in in the bottom, more and more from the east, greatly shortening the extent of the ore deposit in that direction with each successive level.

The mine is wholly underground and has reached to a considerable depth.



There are four shafts in all, but No. 4, the most westerly one, is 300 feet distant from No. 3 and sunk in higher ground, 70 feet above the others.

Descending No. 3 shaft to the third level, 160 feet below the surface, we find the vein worked out to the west 100 feet from the shaft, where a horse of rock comes in, through which a drift has been run 100 feet, and a rising cross cut to the north, 20 feet in length, comes again into ore, a lens lying north of the ore entered by the shaft. It is about 18 feet wide and has been opened east and west, 100 feet. They are not yet to the hanging wall. The ore is hard hematite mixed with rock, and requires a good deal of picking over. This level to the west is extended to connect with the bottom of No. 4 shaft. In this direction, west from No. 3, the formation has been thrown to the north 50 feet. A cross cut connects the two portions of the vein. The opening recently made to the west from the rising cross cut is in this same throw. A cross cut 40 feet into the hanging wall comes to hard, fine-grained limestone.

Descending to the 4th level we find it to be nearly all mined out. Nothing is left but the pillars, which are also being removed and replaced by timbers and loose rock.

In the 5th level they are stoping west from the shaft (No. 3) and have a winze sunk to the 6th level. They have drifted west in the vein 50 feet, and to the east, between No. 2 and No. 3, they have also a stope in this level, 20 feet wide if we include a jaspersy portion along the hanging.

In the 6th level, 50 feet west from the shaft, a few men are at work in the vein stoping and picking out the ore. I observed at a car that two men were shoveling into it and two others stood by picking out the rock.

Further to the west is a cross cut to the north, which is in now 80 feet. They are hoping to strike the vein, which, as seen in the level above, has been thrown to the north.

Going down a winze on the west side of No. 3 shaft brings us to the 7th level, and the shaft is on its way to the 8th level, 450 feet below the surface. To the west of the shaft in this level they are drifting in mixed rock and ore.

To the east to No. 2 shaft the ground is standing almost entire up to the 6th level, and having some ground yet remaining in the 5th. The drift goes to No. 1 shaft. This is the best portion of the mine. The ore is cleaner, less mixed with rock. The vein is 14 feet to 20 feet in width, and pretty uniformly good. They are stoping in this level between No. 2 and No. 3 and between No. 2 and No. 1. No. 2 shaft is sunk to the 8th level, and east of it in the 7th level is a fine stope 18 feet wide, of very clean, blue ore, becoming of a reddish hue along the foot wall. Further east, near No. 1 but west of it, is a wide stope at the end of a large chamber, which is lighted with a Brush electric light.

Between No. 1 and No. 2 in the upper levels has been a fine deposit of ore, but it is worked out, and at the depth now reached the vein has narrowed up considerably.

Added to this there is no ore found at present east of No. 1 shaft, and the pitch of the lens has already carried it west of the shaft, so that No. 1 is likely, ere long, to become useless. The ore will have passed to No. 2.

The length of the mine is now about 500 feet, but there is not that amount of good ground. The main part of the mine is between No. 1 and No. 3, a length of about 250 feet. The ore vein is a mixed deposit, a sort of a conglomerate, widening out to 50 feet in places, but generally at the present depth having a width of from 10 to 18 feet, and affording clean ore only in portions



of it. The general dip is  $70^{\circ}$  north and the hanging wall a chloritic schist. The foot wall is somewhat similar, but becoming a friable, silicious black slate.

The ore is also varied. It is made up of a fine, soft specular blue ore, red hematite, and hard blue ore, all of good quality, high in metallic iron and fairly low in phosphorus—one of the best ores obtained on the "range."

In No. 4 they are mainly "scramming" west from the ragged open pit that lies between No. 3 and No. 4 shafts. There is an underground drift extending west from this open pit, in which some men are at work, but nothing new of importance has been developed. In the pit the ore has been worked out. It was heavily capped over with a coarse conglomeritic sandstone, horizontally bedded, and from 15 to 30 feet in thickness. It constitutes largely the elevation of the surface west from this pit.

From the shafts a gravity incline extends to the west with a descent of 75 feet and a length of 500 feet, down which the ore is run in the cars and out on the elevated track to the ore dock or pockets by the railroad.

About 1,000 feet to the north, they are boring with a diamond drill; are only in 50 feet.

In the engine house are four drums, five feet diameter, which operate all the shafts. Also in the pumping engine house, near No. 3 shaft, are four small drums for lowering timber, sinking winzes, etc. No power drills are used. The number of men employed is about 175.

The officers are Wm. R. Babcock, General Manager; Capt. Elisha Morcom, Superintendent; Capt. John Bodilly, Mining Captain.

The mine formerly belonged to the Menominee Mining Company, but has been sold, and on the first of July passed into the possession of the Cambria Iron Company of Johnstown, Pa. The Cambria also purchased of the Menominee Mining Company, besides the Quinnesec Mine, the Vulcan, the Cyclops, and the Norway Mines. Recently a new company has been formed, under the general mining laws of Michigan, to operate these mines. This new organization is designated as the Penn Iron Mining Company, with general office in Johnstown, Pa, and the Michigan office in Vulcan,—Powell Stackhouse, President; Wm. R. Babcock, General Manager; Wm. S. Robinson, Secretary and Treasurer.

The product of the Quinnesec Mine for the year 1881 was 43,711 tons, and the mine has yielded in the aggregate 164,662 tons.

#### THE INDIANA MINE.

The Indiana Mine is in the N. E.  $\frac{1}{4}$  of Sec. 27, T. 40, R. 30. The main openings are near the east line of the property, near the northwest corner of Lake Fumeè, at the base of the hill, which rises to the north from the low land surrounding the lake. Here are two shafts and a number of test pits. The main shafts are about 100 feet apart east and west. The west one is now intended as a timber shaft and is worked with a derrick. The east shaft is furnished with a skip road, and the shaft house has an ore pocket on each side of it so that the skip may dump its load of ore directly into these pockets, and thence the ore will be discharged into the cars on the railroad track beneath. The engine house is situated a short distance to the north, and between it and the shaft is the stock pile. There are about 2,000 tons of ore in stock, soft specular blue ore, but it is somewhat mixed with rock.

The shaft is 75 feet in depth below the collar, at the surface of the swamp. The hanging and foot walls have not been satisfactorily determined, and too little has been done to ascertain how wide a deposit of ore has been entered. Enough is indicated, however, to insure a fair prospect for a successful mine.

A diamond drill boring was attempted a few hundred feet west, but only penetrated 150 feet, it being found too difficult to proceed. The hole would cave in and fill up as fast as it was bored. They are now operating the drill at a considerable distance to the south, west from the lake, but slight progress has as yet been made; the work having but recently been begun, and the ground being very wet and the rock deeply covered with drift, it is somewhat difficult to get to the ledge.

Some of the trial pits which were sunk east from the shaft are said to have reached the ore, but they are at present filled with water.

A branch from the Northwestern railway is nearly graded in to the mine. It starts from the main line east from Quinnesec and makes a circuit around the south and west sides of Lake Fumeè, reaching the mine from the west, and will, if necessary, be extended to the Illinois mine.

The mining work is under the supervision of John Swartz, Mining Captain.

#### THE ILLINOIS IRON COMPANY.

The Illinois Iron Company's property lies adjacent to the Indiana Mine on the east, being the N. W.  $\frac{1}{4}$  of Sec. 26, T. 40, R. 30. Some exploring work was formerly done here by an organization styled the Scandia. The lease was recently purchased by the parties representing the Illinois, and the latter company organized.

The present work is embraced in two shafts, the west one of which is down 91 feet below the surface; at the bottom of this vertical shaft a drift extends to the south 80 feet. The drift is in a brown, lean ore and rock. The shaft is near the line between the properties, and is called the Union Shaft. Three hundred feet further east is another vertical shaft, down to a depth of 94 feet, and from the bottom has a short drift to the south. Judging from the rock that has been hoisted no clean ore has been reached in this shaft. Work in it has for the present been discontinued, through the failure of the steam boiler. A new boiler, however, has been secured, and the work of extending the cross cut from the bottom of the shaft will be resumed.

The Superintendent of the operations is Capt. John Traverse, and a force of 11 men is now worked.

#### THE CORNELL MINE.

Northwest from the Indiana, in Sec. 20, E.  $\frac{1}{2}$  of the N. W.  $\frac{1}{4}$ , is the Cornell Mine. This location is on the rising ground to the north, and overlooking Lake Antoine, a beautiful sheet of water, along the pleasant margin of which runs the road leading from the mine to Quinnesec. The mine is idle and has remained so for some time. The ore deposit, which was worked, was exhausted, and no new ones were discovered; perhaps too little effort was made. The discovery of ore here was only made in 1879, and it is barely reasonable to conclude that the one deposit was all that exists. The strike of the formation is N. 55° W., and the dip 70° to the southwest. Capt. John Wood, the Superintendent, resides upon the property, but is about to remove to the St. Lawrence Mine. It is stated that it is the intention of the Cornell

owners to employ a diamond drill in exploring the location. The mine has produced, during the years it was worked: 1880, 30,856 tons; 1881, 11,816 tons.

#### THE KEEL RIDGE MINE.

The Keel Ridge Mine is owned by the Emmett Mining Company, and the estate comprises the S.  $\frac{1}{2}$  of Sec. 32, T. 40, R. 30. The mine is situated upon the side hill facing the south, at a distance of about a third of a mile north from the main branch of the Northwestern Railway. The mine being in elevated ground affords excellent drainage, and also facilities for disposing of the rock and handling the ore to advantage.

Only one shaft is now worked, which is down to the 280-foot level, though they are now stoping in the 220-foot level. In this level the vein is from 15 feet to 30 feet wide, and is opened by a drift to the east from the shaft, a distance of 116 feet, and to the west 90 feet. The drift, each way, terminates in rock; the level above, 180 feet, was longer; the mine has shortened at both ends with each successive lift; formerly three shafts were worked. The one now operated is No. 2.

At the surface the vein was separated into two parts by a wedge of rock; the two portions unite further down and are now one vein. The ore in the south vein, or south part of the vein, is high in phosphorus, and is kept separate from the north vein ore, which is Bessemer. The strike of the vein is N. 75° W., and the dip is nearly vertical. The location is about midway between Iron Mountain and Quinnesec.

The mine produced in 1880, 11,445 tons, and in 1881, 19,011 tons. The estimated product for 1882 is 30,000 tons. The company employs 110 men. The local officers are: J. T. Jones, Agent; John Wicks, Mining Captain.

#### THE CYCLOPS.

The Cyclops is one of the mines recently purchased from the Menominee Iron Company, and now controlled by the Penn Iron Mining Company. Its appearance has very much improved of late, and from being what, by some, was regarded as an exhausted mine, it promises to again become a valuable property.

Work has recently been resumed in the Curran, or No. 2 pit, the most westerly one adjoining the Norway, with the best results. This pit had been abandoned by the former company, as it appears, just as the main body of the ore was reached. Captain Oliver has opened a tunnel, driven from the south, beneath the highway, on a level with the bottom of the pit, and cut away the timbers, the lower ends of which were planted in the ore and supported the overhanging sandrock, in the north wall of the pit, and driven on north 60 feet in ore. The open pit has been widened and extended, the rock cleaned away, and there is now exposed a face of ore, underlying the sandstone, of a width of 40 feet, east and west, and of a height of 15 feet, and the drift to the north is in 20 feet, and is still in clean ore; the bottom of the pit is all ore, so that they have thus far a width of this deposit of 40 feet, and a further extent to the north, as yet undetermined. The length of the deposit east and west is not yet known. It is a soft, blue ore, unmixed with rock, and is being very cheaply mined. The rock and ore are loaded into tram cars and run out through the tunnel to the rock dump and to the ore



cars. The overlying sandstone is a horizontally bedded conglomeritic rock, with pieces and bunches of ore scattered through it.

In No. 1 pit, west of the Curran pit, they have sunk a shaft 80 feet below the old bottom, and drifted to the east 100 feet. They now have a vein of blue ore 10 feet wide, in this drift, and are following it east. To the west is the same level; they have drifted 75 feet, and then branched off to the north, the drift to the west being also extended. No good ore has been found in either branch. It is decided to continue this north drift across the formation for several hundred feet, and if anything of value is found a shaft will be sunk to the ore.

Looking into the east end of No. 1 pit we see, near the lower line of the sandstone, horizontal seams of ore interspersed in the sand rock, succeeding and running into each other. The bottom of No. 1 open pit is rock, so that the underlying deposit in which the east drift is extending is a distinct vein.

Going to No. 4 and descending to the bottom we find a drift to the west in a mixed ore, and rock that is of no value; but a short drift to the north cuts a 5-foot vein of clean ore, in which they have drifted west 80 feet, and the ore still continues. At the west end they have "raised" in the ore 30 feet, and in this also it proves equally good. Going east from the cross cut the vein does not prove as good. It is mixed with rock.

No. 5 pit, which is at the head of the incline, has an ore vein 10 feet wide, in which they are now mining. A double track gravity incline railway runs from this shaft down to the level below. The mine is operated almost as a part of the Norway. The same Superintendent and Mining Captain looks after both mines.

The mine made its first shipments in 1878, 6,275 tons; in 1879 it yielded 46,472 tons; in 1880, 14,368 tons; in 1881, 12,644 tons.

#### THE NORWAY MINE.

The Norway Mine is the largest of the mines included in the recent purchases by the Cambria, of the Menominee Company. Heretofore it has been the largest producer of ore of any mine in the Range, and will only now, in the present year, be surpassed in the product, by the Chapin. The yield of the mine in 1881 was 137,077 tons, and the total for previous years was 279,288 tons. The mine is looking well, and there will be no difficulty in making the output, the present year at least, equal to that of the last. The formation is very much broken up and irregular, and the ore "makes" in pockets, but the pockets or lenses are large and seemingly persistent, or if the ore gives out in one place it reappears in equal magnitude in another level. And while it requires somewhat persistent searching to find it, there is no cause for alarm. The effort to find the ore is generally rewarded with success.

The mine openings are along the brow of the hill which slopes to the south to the swamp below the village of Norway. The length of the mine east and west from the Oliver shaft, the most westerly one east to the Perkins line, is 1,800 feet. In this distance there are nine working shafts, the deepest being at No. 1, the east end of the mine, where they have opened below the surface 250 feet; thence to the west the depth of the mine varies, being generally less than 100 feet; No. 2 is 240 feet; No. 3, 193 feet; No. 4, 190 feet; No. 5, 188 feet; No. 6, 188 feet; No. 7, 93 feet; No. 8, 95 feet.

There are four levels, but the eastern part of the mine is the only portion



that is down to the third and fourth levels. The third level is opened from the east end west 400 feet, mainly in drifts. The fourth level is in rambling drifts, the main one making a complete circle of about 150 feet in diameter, and 10 feet to 20 feet wide. It is entered in No. 1 and No. 2 shafts. The dip of the formation is south, and the strike northwest and southeast. Nos. 3, 4, 5, 6, 7, 8, 9 shafts are to the second level, and this comprises 1,400 feet of surface length of the mine. In all of these some work is being done. The great deposit that extended from No. 4 west 900 feet is worked out, and below the mine is a multitude of drifts and pockets opened in every direction, and in every position and shape.

Going to the west end of the mine we enter No. 8 pit; the Oliver shaft, further west, has not much depth, and has no ore; it will be further opened and proved, ultimately, by drifting under it from the east. In No. 8 is, apparently, to be seen a large body of ore, perhaps the largest which the mine affords. The bottom is 90 feet below the surface and is ore; the west end is a breast of ore, 30 feet wide on the bottom, 50 feet on top, and extending upward nearly to the surface, with the exception of the chamber opened above, to the west. Climbing up the stope 20 feet we enter this chamber, 50 feet wide and 100 feet long, having its roof, bottom, and south sides of ore. Following a drift to the northwest 100 feet, and then turning south 40 feet, we come into a chamber which is being opened in the same deposit. The ore here is 70 feet in width, but to the west end a horse of rock comes in across the vein. This has been broken through and a short distance beyond. No. 9 shaft is coming down and will soon be ready to work this end of the mine. A drift has been started in the ore towards the Oliver shaft, which is 300 feet west. The company has here, in No. 8 pit, an assured product, and a large one. This body of ore has a width of 50 feet and a length of 200 feet. This lens of ore, like all the others in the mine, in fact, similar to the ore in all the mines in this section of the range, inclines to the southwest; that is, the formation dips to the south and the ore pitches to the west.

The ore in the bottom of No. 8 open pit is mined from the west end, and shoveled into cars, in which is trammed to the shaft.

No. 7, next east from No. 8, is a long, open pit that is only worked by scrammers; they sunk in the bottom 40 feet, and drifted south without finding any ore.

Next east is No. 6; here they supposed that they had a wide bottom of ore, but in testing it, it was found to be rock covered with a foot or two of ore. The foot wall had suddenly flattened and reached out, horizontally, 800 feet to the south. They are now working south of the old bottom and following the ore in a drift under the hanging wall; but 70 feet below this drift two others have been driven to the south and southwest, and neither reached good ore, but in both a considerable stream of water was "cut." The ore from No. 6 comes from the upper, open level. In No. 5, going south from the shaft, they have a breast of ore on the south side, 40 feet wide and carried 25 feet high. A drift to the southwest, from this pit, 40 feet long, loses the ore; it comes in south of those from No. 6. To the southeast the drift is in ore. On this side the width of ore, as shown by the drifts, is 125 feet, and could soon be made available for a stope. The bottom and back are ore. It is a new pit, and a very promising one for present working, as well as for future product.

No. 5 is divided into two pits by intervening rock. Going into the east part through the aperture in the wall that divides them, in the second level, we find

a long drift 200 feet to the southeasterly, mainly in ore; the drift turns more to the east and continues 40 feet, to meet a drift from No. 3. Here also is a large body of ore that has thus been crossed for a distance of 200 feet. Near the wall in both pits they are mining out ore, and hoisting it from No. 5 shaft. Passing east up over a stope and through an aperture we come into No. 4, into a chamber of good ore, with a considerable quantity lying broken in the pit. Going east through a drift in ore 50 feet, which is succeeded by rock, and continues in it east 200 feet, it turns south and extends 100 feet, and will be continued to meet a drift from No. 5, making a complete circle. These drifts are made to explore the ground. Passing east we come finally into No. 3 open pit, and continuing we enter the large chamber down through which extends No. 3 shaft. Descending this to the third level, we find an opening to the west 170 feet long and 30 feet wide; below this floor, 70 feet down, and 175 feet west from the shaft, is a drift in ore. This would indicate that they have, at least, a body of ore 30 feet wide on top, 70 feet deep, and 175 feet long; 60 feet west of the shaft is a winze sunk to the fourth level, and stoping has just begun in this level.

Going east from No. 3 shaft in the third level, and turning north, we come into a large north vein running east and west. A drift is extending to the north to come under No. 3 open pit, to reach the ore that lies in that bottom.

Going west we descend to the fourth level, the bottom of the mine, coming into a chamber with ore on all sides, the meeting place of two veins,—the Stephenson, and the so-called B. B. vein, of Norway. The Bessemer and the non-Bessemer are producing deposits. A drift south 50 feet, in ore, intersects an east and west drift also in ore.

To the east 40 feet brings us to No. 1 shaft. This is all new opening, but recently penetrated, and is very encouraging, though it is not fully explored.

East 100 feet from No. 1 is No. 2, which will not be sunk any further as the ore pitches to No. 3. It furnishes but little ore. South from No. 1, through 75 feet of dead ground, brought them to ore in which they are driving, being in 20 feet. The ore from this drift, and from one other small stope is all that goes to No. 2 shaft.

Going up to the third level and around into No. 1 pit we come into what has, until recently, been one of the most productive portions of the mine; but it is getting to the end, and will be replaced by the same shoot now opened in the fourth level, previously described.

Going through the Norway one is convinced that the mine has an abundance of ore. There is nothing regular or certain about the deposits; they work out or are cut out by the foot wall or protruding horses of rock. A large amount of drifting is done, as of necessity there must be, if the product is kept up. These drifts ramify in all directions, and are mainly satisfactory in results.

Capt. Oliver evidently comprehends the situation, and strives to keep the mine well opened ahead, so that he may calculate on his product and know where it is coming from. Comparatively but little timber is used in the Norway Mine. The rock and the ore deposits are tolerably firm, and thus far the necessity for the use of timber has been avoided. Perhaps no mine on the range mines its ore more cheaply than the Norway. The facilities for handling ore are excellent. The railroad track has a descent sufficient to run the cars down to the ore pockets or docks, and thence out on the line.

Above, running from No. 9 shaft east is an automatic railway, which carries

the ore from the most of the shafts to the pockets. Nos. 5 and 6 yielding non-Bessemer ore, it is trammed to separate pockets. A new stone compressor and pumping engine house have been recently built and furnished with a single compressor and an 18x48-inch pumping engine, made at Iron Bay Foundry, Marquette.

The weekly product is now 2,500 to 3,000 tons; for the week ending July 8 the product was 1,859 tons of ore, 529 tons of rock, but this week included one holiday, and was also the first week in the month, when there is always less ore hoisted than in the other weeks of the month, for the reason that the last week the miners always clean up all the ore that is broken in the mine.

The Superintendent, Capt. John Oliver, is evidently a thorough miner and a good manager, and he has a competent assistant in Capt. James Watkins.

A force of 500 men is employed, and there are about 200 buildings on the location, including dwellings, shops, etc. The adjacent village of Norway is one of the most thriving towns on the range.

The ore is of good quality. The so-called vein matter is sufficiently characteristic to be readily distinguished. It is a somewhat soft, yellowish conglomerate, made up of bits of ore and rock. Drifting in this costs from \$4 to \$6 per foot, depending on the air.

The description of the land in which the mine is located is the N. E.  $\frac{1}{4}$  of the S. E.  $\frac{1}{4}$  of Sec. 5, T. 39, R. 29.

#### THE PERKINS MINE.

The Perkins Mine joins the Norway on the east. In the third level in No. 1 pit in the Norway you may pass into the Perkins through an opening between the mines. The Perkins has been, and still continues to be a very profitable mine, though it is a short one, and is now shortening up rapidly at the east end. There are three working shafts numbered from the west, next to the Norway, toward the east.

Descending No. 3, the east shaft, we arrive at 85 feet at the first level, where there is no work doing; a drift was run to the east 175 feet, and a cross cut south 25 feet, but no ore was found. Twenty-eight feet further down we come to the second level; at the foot of the shaft is a cistern with a double action Knowls pump, 8-inch cylinder, 6-foot stroke. The ore to the east of the shaft was shortened 35 feet in length from what it was in the level above.

Descending again 30 feet to the third level, they found the ore held out 75 feet east of the shaft to a width of 6 feet, when it was cut out by the underlying rock. A drift was extended east 150 feet, all in rock; they are still working this drift with little prospect of success. The vein rock, in which they are drifting, has almost the appearance of ore. A boy with a hand machine is kept at work blowing air into the drift for the men.

Fifty feet east of No. 3 shaft they run a drift to the south a distance of 75 feet, all in the vein rock, but found no clean ore. The drift terminated in the slate hanging wall. In this level, west from the shaft for 20 feet, the bottom is rock, when it drops down to the bottom of the next level, the rock again occurring in the east end of this, the fourth level, in the same manner, driving the ore further west, or rather cutting it out on the east.

Going down to this level we find that they have drifted to the east 20 feet in mixed ore, etc., and are sinking the shaft in the same. The shaft is down 30 feet below the bottom and will be sunk 100 feet to prove the ground.



West from No. 3 shaft in this level they are working a breast of ore 15 feet wide that has a run of 40 feet to the breast on the opposite end of the same block in No. 2 pit. The foot wall, however, in the bottom is crowding the ore out against the hanging. The pillar on the west side of the shaft has been taken out, as the rock bottom, which must remain, will suffice to support the walls. Ascending the stope to the west and passing around the north side of a pillar, we come to the stope on the west end in No. 2 pit. This body of ore is 30 or 40 feet high, 40 feet long, and 15 or 20 feet wide. Descending the stope to the west, we are in No. 2 pit east of No. 2 shaft, where they are working east towards No. 3.

The bottom is ore, 110 feet long and 25 feet wide, and a winze sunk in this bottom between the stope and No. 2 shaft is in ore, as is also the shaft, which has been sunk to another level. This body of ore continues to No. 1, 210 feet, with a width in the bottom of 20 feet to 30 feet. In this No. 2 pit the foot wall comes down cutting under to the south, but the hanging wall seems to make off correspondingly, so that it is probable that the ore holds its size. Going west, up over the stope and through an arch in a pillar, we come into No. 1 pit, in the east end of which is a stope 20 feet wide and 30 feet high. The bottom of the pit is ore, with an average width of 18 feet. Another level sunk below this shows equally well. Going west of No. 1 shaft the ore deposit widens out and has been worked for 50 feet, having a breast of ore in this level of 15 feet wide and 80 feet or 90 feet long, to the Norway line. The width is, apparently, much greater, owing to the increased flatness of the vein at this point. It probably makes a run off to the south as it goes down, and will be found below to correspond with the lens formed in the 4th level in No. 1 in the Norway.

No. 1 and No. 2 shafts have each a skip road. Until recently they were both worked with bucket.

Ascending in No. 1 to the next level, we see that they are driving around north of the shaft to take out some of the ore that is standing east of the line.

The vein is wide; it has been opened to a width of 30 feet against the foot wall, and there is fully 40 feet of standing ore towards the hanging.

The bottom of this level is 235 feet below the collar of No. 1 shaft. The bottom of the level below is 275 feet under the surface. The back of the upper level is ore, left very thick to support the heavy weight of sand and refuse that rests upon it in the open pit above. Ultimately this refuse will be let down below and the ore that supported it will be taken out.

The dip of the walls is about  $70^{\circ}$  and quite regular in the west part of the mine for a depth of 230 feet, when they flatten off to the south. The mine is opened close to the north line.

The weekly product is about 1,600 tons, and there are about 10,000 tons in stock. The product will be about the same as last year. The force employed is 200 men.

The shaft houses are on the north side of the open cut, so that the elevated tracks to the ore pockets pass over it. There are six double ore pockets, one for each shaft. The railroad cars pass under the pockets with a descent to admit of their running down by force of gravity.

The engine house contains four Lane drums, five feet each diameter, and two small ones for use underground in sinking winzes and also in lowering timbers. Some very long, heavy timbers are used in the west end of the mine.



The description of the location is the S. W.  $\frac{1}{4}$  S. W.  $\frac{1}{4}$ , Sec. 4, T. 39, R. 29. The company also holds three forties to the east, on one of which, east from the mine, an attempt has been made to sink a shaft, which is down to a depth of 93 feet in drift, when the water proved too abundant for the pump. A larger pump has been set to do this work, and further effort to lower the shaft will be made.

The mine is the property of the Saginaw Mining Company. Capt. Sam Mitchell, Agent, Stoneville, Mich.; Capt. John Perkins, Superintendent, etc., Norway, Mich.

The product of the mine in 1881 was 60,406 tons, and the aggregate yield to the same date is 123,331 tons.

#### THE STEPHENSON MINE.

The Stephenson Mine, joining the Perkins on the north—being the N. W.  $\frac{1}{4}$  S. W.  $\frac{1}{4}$  Sec. 4, T. 39, R. 29—is idle. The ore deposit in which the mine was worked has passed to the Perkins side of the line, and no other discoveries having been made, there was no longer any ore to mine.

The mine produced in 1881, 10,856 tons, and the product for previous years was 24,129 tons.

It is the property of the Lumbermen's Mining Company. Hon. H. Ludington, Milwaukee, President; Hon. Isaac Stephenson, Marinette, Wis., Secretary; Geo. E. Stockbridge, General Manager.

#### THE BRIAR HILL MINING COMPANY.

The Briar Hill Mining Company has a small mine, east from the Perkins and joining the Curry on the west. They are working one shaft, which is situated in the northwest slope of the bluff. The ore drawn up from the shaft in buckets is dumped on the west side or into cars, which tram it on an elevated track 400 feet south to the railroad. The ore is soft blue specular of the quality that is esteemed so highly by the steel makers. The ore lying below on the west side of the shaft is drawn up an incline on to the elevated tramway, whence it is run out to the cars. There are about 5,000 tons in stock. The shaft is vertical, 180 feet in depth, and there is a stope of ore in the west end of the bottom drift, but nothing in the east end. The ore deposit dips south and pitches west, and is rapidly cut out in the east.

An exploring shaft is sinking 100 feet south of the engine house, and near the east line of the property between it and the Curry a diamond drill is boring to the north, across the formation, at an angle of 70°.

The machinery comprises two three-foot drums worked by two 10x14 Rochester engines.

The work is in charge of Thomas W. Williams, Superintendent, etc., and a force of 45 men is employed.

#### THE CURRY MINE.

Next east from the Briar Hill is the Curry Mine, situated in the N. E.  $\frac{1}{4}$  N. E.  $\frac{1}{4}$  Sec. 9, T. 39, R. 29, and joining the Vulcan on the west. The mine has been worked since 1879, producing in the aggregate 52,285 tons of ore. The yield in 1881 was 17,534 tons. The mine has now narrowed down to small dimensions—to a single stope in the west end of the bottom drift.

The shaft is down 200 feet below the surface. The formation is vertical for 80 feet, and then makes a slight underlay to the south. In the bottom the ore has been followed to the west 100 feet, having an average width of 7 feet. At the end, however, the stope is about 12 feet wide, from which they are mining an average of 50 tons per day (July 14th). The ore pitches to the west, and has been rapidly shortened to the east by the undercutting rock. In tramping from the stope to the shaft, the car has to be run up an incline of rock that occurs in the bottom lengthwise with the drift. A winze has been sunk for taking out another level. The winze is in ore.

The number of men now employed is 50. The engine house is supplied with three 3-foot drums. The ore is the soft blue specular of the Vulcan Mine.

The stock is mainly held by Joseph Outhwaite, Cleveland, Ohio. The Agent is Wm. Ross, Vulcan, Mich.; Mining Captain, Wm. Wilcox.

#### THE WEST VULCAN MINE.

Next east to the Curry a short distance is the West Vulcan Mine, so well known and esteemed among furnace men for the excellent quality of its ores. The mine is on the southerly slope of the hill which extends indefinitely east and west, and at this location terminates finally, 100 rods to the south, in a small lake. The location has very much improved in appearance within the past year. The fallen timber has been cut up into wood, the worthless logs and brush got together and burned up. Yards, gardens, and cultivated fields appear where but recently were only logs and brush. The dwellings have been repaired, painted, and made neater and more comfortable, and thus altogether the surface outlook is much more inviting.

This improvement has not been confined to the surface. An effort, which is far from being devoid of excellent results, has been made to change for the better the mines themselves, and thus the evidence of the control of a thorough master is generally manifest. The West Vulcan was, until about two years ago, worked in open pits, and at the east end of the mine is a pit 50 to 75 feet wide, 200 feet long east and west, and 50 feet deep, in the center of which the shaft descends below the bottom dipping to the south and rising to the surface on the north side of the pit. The ore that is hoisted in this shaft is brought up to the bottom of the pit and dumped into cars, in which it is trammed out to the south through a tunnel under the road way to the pockets and ore dock. After this season the ore will be hoisted to the surface, to the top of the shaft house, on the east and west sides of which are pockets for receiving the ore. A trestle will be made over the chasm to carry the tramway, and the ore from all the shafts to the west will be brought east, and thence over this trestle to the pockets and ore dock. The waste rock that must be removed from the mine will be dumped into this old chasm. In the west end and in the southwest course of this open pit, some miners are scrambling in small pockets of ore.

West from this No. 1 pit, 180 feet, is No. 2 shaft, which goes down from the surface inclining to the south, and in it has lately been placed the new Cornish plunger pump. Close by the shaft on the southwest corner is the Stone pumping engine and compressor building.

Directly north of No. 2 about 300 feet is No. 3 shaft, and close by it to the west they are now opening and lining up a shaft for taking down timber into the mine.

Just east of No. 3 is the main engine house, which is furnished with three 5-foot drums, one Rochester, and two Frazier & Chalmers. There is a small drum in the pumping engine house for operating the timber shaft near No. 3.

One hundred feet further north and 400 feet west of No. 3 is No. 5 shaft, and between the two is No. 4. The depths of the shafts are as follows: No. 1 is down to the fourth level, 300 feet below the surface; No. 2 is down 220 feet; No. 3, 220 feet; No. 4, 312 feet; No. 5, 200 feet.

The ore from Nos. 3, 4, and 5 shafts is run down a gravity incline to the pockets and ore dock. This arrangement, as before stated, will be changed, so that the ore from these shafts will be taken around over No. 1 pit on the trestle. Passing through the tunnel into No. 1 open pit, and descending the shaft to the first level we notice that they have gone into the hanging a short distance, and from the end of the cross cut are drifting east in a vein of soft blue ore 8 feet wide. West from the shaft, in this level, the vein is worked out, having an open chamber 70 feet wide. A cross cut, started 50 feet west from the shaft, south into the hanging, intersected at a distance of 23 feet, a narrow vein of blue ore, in which they are now drifting east and west. A characteristic of this vein is the occurrence in it of bunches of hard jasper. It is intended to continue cross-cutting to the south until the hanging wall is reached.

Going west to No. 2 shaft in this level we notice that it is sinking in rock, in the foot wall, so that we pass through a cross cut 50 feet north to reach it. The pump in it is a 12-inch plunger, 6-foot stroke, and would suffice for much more work than is at present allotted to it.

The first level is mainly worked out, leaving wide chambers with the roof supported by pillars and timbers.

In the second level, in which they are now working, the foot wall makes a roll to the south and then goes down as before; the ore deposit is thus greatly narrowed. A cross cut to the south into the hanging wall intersects a lens of ore, which has been drifted in some distance, and which will be opened into from the level below. Down 40 feet towards the third level from the second the vein has narrowed to about 40 feet.

The plan is to take out all the ore except the pillars on each side of the shafts, replacing with timbers, arranged after the Nevada system. In No. 1 level a bottom has been left because the timbers from below do not exactly come under these in this level. The water in this level is run to a cistern at the pump shaft into which is also elevated the water from below, using a No. 6 and a No. 10 Knowls pumps. The plunger pump thence takes it to the surface. The cross cut to the lens in the hanging wall is much shorter, but the width of the vein is about the same as above. The main lens narrows, and so continues to do in the levels below.

Near No. 1 shaft a drift to the south 15 feet long is yet in rock, but it is probable that the ore will be struck still further south. At the shaft is placed a small drum and compressed air engine, used in sinking the shaft.

Descending to the third level and going west about 40 feet through a drift in rock, and turning south through a cross cut 30 feet, we come into ore, in which they are now driving east, and have a breast of clean blue ore that appears to widen out by opening, on the south side, more into the foot wall. West of the shaft 10 feet is a cross cut south, which, after going through 30 feet of rock, comes into the same lens of ore in which the cross cut continues 25 feet, without yet reaching the hanging wall. Further west from the shaft



is another cross cut to this ore, and a winze has been sunk in it to the fourth level. It is a deposit south of the main lens. One hundred and ninety feet west from the shaft is a stope 20 feet wide, which they are now working. The shaft has been sunk to the fourth level, the winzes also sunk and some drifting done and cross cuts made; the vein has an average width of about 20 feet, having narrowed from the first level when it was 70 or 80 feet wide. In this third level a cross cut is driving north in the foot wall to the pump shaft. The shaft is 130 feet distant and the cross cut is now in 70 feet, and in rock, or mixed vein rock. The fourth level is 75 feet below the third.

There is as yet no connection, though underground, to No. 3; so ascending to the surface and catching a momentary enjoyment of sunlight while passing over to No. 3, we again take to the ladders and are soon dependent upon the feeble light of our candles to find our way through, otherwise, impenetrable darkness.

The timber shaft at No. 3 has been made by sinking from the surface to the old workings. It proves a great convenience, saving any interference with the main hoisting shaft.

At the bottom they have a 4-foot vein, east from that shaft, but are not now working in this direction. They intend to wait until the shaft is completed to the fifth level, and then to drift east and open out above. The ore here seems to pitch to the east and ought to widen out in that direction as they go down. A cross cut will be made south to No. 2, and water from No. 3 run to No. 2 pump. West from No. 3 shaft, in the fourth level, the vein is 10 to 15 feet wide, increasing further west to 25 feet. The men are stoping above, dropping the ore against the lagging that stands obliquely over the drift, from behind which it is drawn out through apertures into the cars, in which it is trammed to the skip. To the west, 90 feet east of No. 4, is a winze to the fifth level. The vein looks poor, as it also does in the drift which is run 50 feet from the bottom. The water is conducted to a cistern west of No. 4 shaft, where a plunger pump takes it to the surface. A No. 10 Knowles pump, double action, has been placed here to be used in case of accident to the main pump. The water in this part of the mine rises very rapidly, and a short time ago, through stoppage of the pump, got the better of them and gave much trouble, causing the mine to lie idle nine days. A small hoisting engine is also in place here, and is used in sinking the shaft. A second Knowles pump has lately been placed near the foot of this shaft, to be used in raising water to the boilers in case the necessity arises, through temporary failure of the pump in the engine house. About one-half the entire product of the mine is taken from this pit, the ore being hoisted, mainly, in No. 4 shaft. To the west 50 feet from the shaft the foot wall comes in and narrows up the vein. The foot wall is much broken up.

Ascending No. 4 shaft to the third level, and going west towards No. 5, we see that the vein has been large, 40 feet wide, but that it has been squeezed out, below, by the foot wall. This part of the mine, in the vicinity of No. 5 shaft, was abandoned, but some work is again being done in it, and the ore, here and there, in places where it occurs, is being scrambled out. Behind the shaft, north of it, is a short drift in a fine deposit of blue ore, and the same deposit is cut in a cross cut further west, but it is only 2 feet wide. This last cross cut is driven to the south 400 feet and is now in the Norway formation. It is continuing with the hope of striking the Norway ore. The drift is 170 feet below the surface, in the second level.



No. 5 shaft is not sinking, but a drift from the east is coming under it, and if it is found to have no ore, at greater depth, the pillars will be mined out and the shaft abandoned. The machinery for this part of the mine is a 5-foot Rochester drum and engine for No. 4 shaft, and a small drum for No. 5. The pump is hardly of sufficient capacity for the work it has to do. It is making ten strokes per minute where it ought to make but six or seven. When the cross cut is made from No. 3 to No. 2 a portion of the water will be distributed in that direction.

The Mining Captain at the West Vulcan is E. S. Roberts, who came here at the beginning of the year, January 1, and since the same date the direction of affairs here, as well as at the East Vulcan, has been in the hands of Mr. A. C. Davis, who, since 1848, has been much of the time a mining agent mainly in the copper district, at the Norwich, Amygdaloid, and Minong Mines. The application of his energy and experience is apparent, to the advantage of the mines now in his charge.

#### THE EAST VULCAN.

The East Vulcan is a mile distant. The workings here are embraced in three separate and distinct mines, or shafts, the center one of which is No. 1, and is 1,300 feet and 1,400 feet respectively distant from No. 2 and No. 3, the east and the west shafts. These shafts were formerly crude affairs, sunk in the bottoms of open pits and lagged up with poles, and operated with buckets and derrick. The shafts are now being well timbered. No. 2 is divided into three compartments, two of them for a double cage and the other for pump. It is down 260 feet, and is a very wet pit. At 200 feet below the surface a drift to the east 175 feet long, from the main pit, is all in ore, the vein showing a width of from 4 feet to 8 feet. A winze will be sunk and a stope made as soon as the shaft is ready for hoisting. The ore is the best—soft, blue specular. The timbering in this mine is somewhat different from that adopted in the other mines on the Range, and possesses an advantage on the score of simplicity and cheapness. The posts are of the same length, 7 feet high, and are set at equal distances apart, in rows at right angles to each other. The cross pieces are of the same length and reach from post to post, so that the top of each post has the ends of four cross pieces resting upon it. The whole bottom is curved in this way, the timber floor on top of the posts, dividing the space into squares. On these timbers the lagging is placed for a floor, to take out the back for another rise, when another set of posts, directly in line with those below, are placed above them and capped as before with the cross timbers; and so on, in successive stages, this arrangement will be continued to the bottom of the mine. There is no mortising, but a dowel, or short tenon is made on the end of each post, against which the ends of the cross pieces are pressed, and thus prevent any sliding or tipping of the posts. The outside posts are stayed by short pieces passed between the posts and the wall. The whole frame work is thus firm, and the posts are kept vertical to receive the downward pressure.

No. 1 pit is well opened and has several good stopes of ore to work as soon as the shaft is ready to hoist. This is called the Lowell pit, and the product goes by the name of Lowell ore. It has a new engine house, in which is a 5-foot Rochester drum.

No. 3, 1,400 feet to the west, is further up the hill, and the ore is brought

down to the railroad on a gravity incline. No ore is now hoisted from the shaft, the mining work being deferred until the shaft is completed. The several pits are in condition to afford a good weekly product, and will be worked as soon as the shafts are ready.

The Mining Captain is John U. Curnow, who has been at the mine since January 1.

The East Vulcan is in the S.  $\frac{1}{2}$  of the S.  $\frac{1}{2}$  of Sec. 11, T. 39, R. 29.

The Vulcan Mines are now owned and operated by the Penn Iron Mining Company, being one of three included in the Cambria purchase. Possession of these mines was taken on January 1, 1882, by the new owners, though they are worked the present season to fill the contracts previously made by the Menominee Company.

The product of the Vulcan in 1881 was 85,274 tons, and the aggregate of its yield to that date is 258,751 tons.

#### THE GARFIELD MINE.

Another location just east from the Vulcan may be noticed, since it is so near by. It is called the Garfield Mine. It is about 300 feet east from the east shaft of the East Vulcan. They are sinking two shafts about 200 feet apart, and each is about 50 feet deep. They have a small hoisting and pumping engine, etc. No ore has yet been reached.

Further east, at Waucedah, are the now idle Breen and Emmett Mines, which are among the first locations that were explored in the Menominee range.

#### THE BREEN MINE.

The Breen Mine is located on the N. W.  $\frac{1}{4}$  N. E.  $\frac{1}{4}$  Sec. 22, T. 39, R. 28, the company also owning the N. W.  $\frac{1}{4}$  of the same section. This mine, which geologically presents some interesting features, was very fully described in the report of 1878. The mine product up to the close of 1880 was 17,440 tons, since which time it has remained idle. Just now some parties are exploring it on an option. They began about May last, and sunk one shaft 45 feet, and found 4 feet of ore which they lost in the foot wall. Concluding not to drift for it, they sunk another shaft, and have now in this latter a four-foot vein of blue ore which is widening out. Their progress is somewhat seriously deterred by water.

#### THE EMMETT MINE.

At the Emmett Mine no work has recently been done, though it produced in 1881, 648 tons of ore, and in all has yielded 66,655 tons. This mine, with the general geological features, etc., was also fully described in the Commissioner's report for 1878.

## FELCH MOUNTAIN RANGE.

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The mines in the Felch Mountain Range will soon be made accessible through the completion of the Escanaba and Felch Mountain branch of the C. & N. W. Railway. The road is already graded for a distance of about 20 miles, and it is estimated the whole will be completed by September next, thus bringing the much talked of mines of this district to the front as shippers of ore. The mines of the Felch Mountain district lie north of the Vulcan, etc. mines, in ranges 28 and 29, towns 41 and 42, and until the railroad is completed they are nearly inaccessible. The wagon road which extends from Norway to Felch Mt., 20 miles, is a very rough one.

The principal mines in this range, the ones which have in any measure been developed, are the Northwestern, Metropolitan, Calumet, and the Hecla.

The former is in the N. W.  $\frac{1}{4}$  of Sec. 32, T. 42, R. 28. The work was mainly done in the winter of 1880 and 1881. Near the east side of the property a shaft was sunk 47 feet deep, 32 feet of which is said to be good ore free of rock, which analyzed 62 % in metallic iron. From the bottom of this shaft a drift was run to the south 22 feet, and continues all the way in ore. As generally happens in exploring work done at a distance in the woods, they had poor facilities for getting rid of the water. The strike is east and west, and the dip at this point is 60° to the south. The hanging wall is quartzite, in contact with which is the blue ore, succeeded by the red ore. The ores are, however, separated by jasper.

West from this shaft 150 feet, they sunk another one, going 35 feet through sandstone and coming to ore. The ore was not sunk in, it is said, on account of the water. Still further west, 400 feet, a third shaft was sunk 45 feet, but they did not get through the sandstone owing to the water. From this point south 80 feet, they again sunk 45 feet, the first 25 feet being in sandstone, then 2 feet of quartzite and jasper, succeeded by 7 feet of soft blue ore. These openings are on the east "forty;" the west forty has had much more work done on it. On this space, 160x200 feet, has been stripped, the drift being from 2 feet to 5 feet thick. Here, in this space, is exposed what is assumed to be the ore ledge, showing the soft blue ore similar to the Vulcan, etc. ore, but no sinking has been done in it.

An ore dock has been built and other preparations made for mining and shipping ore when the railroad is built.

### THE METROPOLITAN.

The Metropolitan lies east of the Northwestern, and the Company has done more work and holds a much larger estate. They have 7,000 or 8,000 tons in stock awaiting shipment. The ore is the soft blue specular variety. They

are mining in three open pits, and are opening a fourth one south of the marble. The ore on the surface is 40 feet to 50 feet wide, but narrows down to 20 feet in the bottom of the pits, at a depth of 50 feet. These pits, with the intervening ground, comprise a length east and west of 500 feet. To the south is the Marble, and in that direction 500 feet is No. 4 pit. The ore from it is harder—hard blue hematite ore. The mine is in the west part of Sec. 33, R. 28, T. 42.

#### THE HECLA MINE.

The Hecla Mine and the Brotherton Mine, both in Sec. 8, T. 41, R. 28, are said to be valuable "finds."

And the Calumet Mine is, according to the reports of those interested, proving a bonanza. A force of 65 men is employed, and the ore vein has been cross cutted 54 feet without either hanging or foot wall being reached.



## AGOGEBIC IRON RANGE.

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Exploration continues active in this region and important results are reported. This iron range extends from the Montreal river, in T. 47 N. in R. 47 W., east across ranges 46, 45, and 44. The larger number of the discoveries which have thus far been made have been in T. 47, R. 46, in Secs. 15, 16, 17, and 19. The best "finds" are in Sec. 15, held by the Cambria Iron Company and Messrs. Sedgwick, Maitland, et. al. Messrs. Merritt, Mills & Fay have promising deposits in Secs. 17 and 19. Good ore has been found as far east in this range as Sunday lake in Sec. 9, T. 47, R. 45.

All tools, provisions, etc., necessary for work, must be borne in on the backs of men, which, when the remoteness of the locality is considered, one may realize is a very laborious and expensive undertaking. Ultimately the region will be penetrated with railroads, when will result the development of another important iron region in our state.



# STATISTICAL TABLES.





## STATISTICAL TABLES.

The following table shows the amount of the various grades of salt inspected in Michigan since 1869, the first year of the establishment of the State Salt Inspection:

Years.	GRADES OF SALT IN BARRELS.				Total for each year in Barrels.
	Fine.	Packers.	Solar.	Second quality.	
1869	513,989	12,918	15,264	19,117	560,818
1870	568,326	17,869	15,507	19,650	621,350
1871	655,923	14,677	37,645	19,930	728,175
1872	672,034	11,110	21,461	19,876	724,481
1873	746,702	23,671	32,267	20,706	823,346
1874	960,757	20,090	29,391	16,741	1,028,979
1875	1,027,886	10,233	24,336	19,410	1,081,865
1876	1,402,410	14,233	24,418	21,668	1,462,729
1877	1,590,841	20,389	22,949	26,818	1,960,997
1878	1,770,361	19,367	33,541	32,615	1,855,884
1879	1,997,350	15,641	18,020	27,029	2,058,040
1880	2,598,037	16,691	22,237	48,623	2,676,588
1881	2,673,910	13,885	9,683	52,821	2,750,299

Previously to 1869 the salt production of the State was as follows:

Years.	No. of Bbls.	Years.	No. of Bbls.
1860	4,000	1865	477,200
1861	125,000	1866	407,077
1862	243,000	1867	474,721
1863	466,356	1868	555,690
1864	529,073		

The average price which Michigan salt sold for per barrel in different years is as follows:

Year.	Price.	Year.	Price.
1866	\$1 80	1874	\$1 19
1867	1 77	1875	1 10
1868	1 85	1876	1 05
1869	1 58	1877	85
1870	1 32	1878	85
1871	1 46	1879	1 02
1872	1 46	1880	75
1873	1 37	1881	85

Michigan is now the largest salt producing region in the United States. Its only competitor, to any extent, is Onondaga, which latter it largely leads in production, as will be seen from the following table, which shows the product of the Michigan wells and of the Onondaga wells for the years given :

Years.	No. of bushels produced in the Onondaga Dis- trict.	No. of bushels produced in the Saginaw Dis- trict.
1877.....	6,427,983	8,303,985
1878.....	7,176,197	9,269,545
1879.....	7,934,854	10,390,200
1880.....	8,481,473	13,382,940

The salt is all obtained in what is known as the Saginaw Valley. The following table shows the relative amounts produced in different localities in 1880 :

Counties.	Barrels.
Bay.....	1,081,841
Saginaw.....	1,148,644
Huron.....	256,841
Iosco.....	147,800
Midland.....	41,462
Total.....	2,676,588

STATISTICAL TABLE Showing the Total Number of Gross Tons of Pig Iron Produced by the Blast Furnaces of Michigan, by Charles L. Wright, M. E., Commissioner of Mineral Statistics.

NAME OF FURNACE COMPANIES.	Previous to 1872.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.
1 Pioneer Furnaces <sup>a</sup> .	57,577	7,020	7,388	10,708	15,202	11,205	2,801	9,768	13,169	18,269	17,030
1 Iron Cliffs Furnace <sup>a</sup> .	36,566	3,431	2,000	4,754	338						
1 Collins Iron Company <sup>+</sup> .	15,059	4,250	4,100	3,688	5,277	3,282					
1 Northern Iron Company <sup>+</sup> .	35,021	4,356	3,949	5,973	5,377	3,278	663				
1 Bancroft Iron Company <sup>+</sup> .	31,602	5,006	4,467	6,621	3,098						
1 Morgan Iron Company <sup>+</sup> .	20,512	4,001	4,416	4,839	1,595						
1 Michigan Iron Company <sup>+</sup> .	23,344	4,212	4,116	11,079	10,647	10,015	3,969	10,594	8,956	9,729	4,680
1 Greenwood Iron Company <sup>+</sup> .	25,140	9,362	2,237	6,092	4,239	3,280					
2 Fayette Furnace <sup>a</sup> .	24,626	2,500	2,237	6,092	4,239	3,280					
3 Munising Iron Company <sup>+</sup> .	7,557	4,900	8,760	8,359	9,233	8,119	4,250				
3 Bay Furnace <sup>+</sup> .	7,095	4,900	3,447	6,524	4,615						
1 Deer Lake Iron Company <sup>+</sup> .	7,833	2,720	3,447	6,524	10,940	10,514	6,866				
1 Marquette & Pacific R. M. Co.	1,610	4,954	7,800	3,238	1,431						
1 * Grace Furnace <sup>+</sup> .				1,431		1,272	3,176	4,917	5,329	5,385	* 10,253
1 Carp River Iron Company <sup>a</sup> .		115	509		5,780	4,829	5,647	3,034	6,760	7,776	8,336
1 Excelsior (Peat Furnace) <sup>a</sup> .			2,229	4,702	70						
4 Menominee Iron Company <sup>a</sup> .			2,175	5,803							
2 Escanaba Furnace Company <sup>a</sup> .			4,848	3,451	1,230						
5 Michigan Central Iron Company <sup>a</sup> .	19,518	3,551	3,606	6,219	8,359	10,280	10,957	11,503	11,940	13,405	14,119
5 Bangor Furnace Company <sup>a</sup> .		689	4,533	2,049	2,255	2,472	5,310	5,254	7,500	7,683	
6 Peninsular Iron Company <sup>a</sup> .	33,752	4,834	5,572	549	2,255	3,000	2,000	628	9,395	15,925	5,082
6 Eureka Furnace <sup>a</sup> .	60,000	2,078									
7 Leland Furnace <sup>a</sup> .			† 6,200	3,655	4,061						
8 Frankfort Furnace <sup>a</sup> .			† 6,200	3,655	4,061						
9 Elk Rapids Furnace <sup>a</sup> .			4,061	5,863	8,033	7,100	11,925	12,448	12,477	12,384	
6 Detroit & L. S. Iron Manufacturing Co.	36,404	4,731	4,061	3,808	4,831	3,580	4,805	5,647	4,767	4,767	5,028
6 Union Iron Company <sup>a</sup> .		1,421	4,990	1,670	2,916	3,680	4,275	8,797	8,797	4,949	
10 Fruitport Furnace <sup>a</sup> .											
11 Marlet Furnace <sup>a</sup> .											
6 Detroit Iron Furnace Company <sup>a</sup> .											
Totals	443,306	74,731	104,785	116,233	110,556	86,454	74,375	65,030	89,463	108,728	

<sup>1</sup> Furnaces in Marquette County.  
<sup>2</sup> Furnaces in Delta County.  
<sup>3</sup> Furnaces in Schoolcraft County.  
<sup>4</sup> Furnace in Menominee County.  
<sup>5</sup> Furnaces in Van Buren County.  
<sup>6</sup> Furnaces in Wayne County.  
<sup>7</sup> Furnace in Leelanaw County.  
<sup>8</sup> Furnace in Benzie County.  
<sup>9</sup> Furnace in Antrim County.  
<sup>10</sup> Furnace in Muskegon County.  
<sup>11</sup> Furnace in Mackinaw County.  
<sup>†</sup> Swineford's History.  
<sup>‡</sup> Previous to 1874.  
<sup>\*</sup> Coal or Coke.  
<sup>a</sup> Includes Carp River & P. R. M. Furnaces' product.  
<sup>b</sup> Caseville Furnace—No returns.  
<sup>c</sup> Ward Furnace—No returns previous to 1878.  
<sup>d</sup> Hamtrack Furnace—Not in blast since 1873.  
<sup>e</sup> Charcoal.  
<sup>f</sup> Estimated.





*Showing the Total Number of Gross Tons of Iron Ore Shipped from the Iron Mines of Michigan. By Charles E. Wright, M. E., Commissioner of Mineral Statistics.*

<sup>1</sup> Marquette county.      <sup>2</sup> Monominee county.      <sup>3</sup> Baraga county.      <sup>4</sup> Included in Cleveland product



*STATISTICAL TABLE Showing the Total Number of Gross Tons of Iron Ore Shipped from Lake Superior Iron Mines. By Chas. E. Wright, M. E., Commissioner of Mineral Statistics.*

	Marquette Dis- trict.	Menominee District.	Totals.
Years Unknown.....	75,083	-----	75,083
1854.....	3,000	-----	3,000
1855.....	1,449	-----	1,449
1856.....	6,790	-----	6,790
1857.....	25,646	-----	25,646
1858.....	22,876	-----	22,876
1859.....	68,832	-----	68,832
1860.....	114,401	-----	114,401
1861.....	49,909	-----	49,909
1862.....	124,169	-----	124,169
1863.....	203,055	-----	203,055
1864.....	247,059	-----	247,059
1865.....	193,758	-----	193,758
1866.....	296,713	-----	296,713
1867.....	465,504	-----	465,504
1868.....	510,522	-----	510,522
1869.....	639,097	-----	639,097
1870.....	859,507	-----	859,507
1871.....	813,984	-----	813,984
1872.....	948,553	-----	948,553
1873.....	1,195,234	-----	1,195,234
1874.....	899,934	-----	899,934
1875.....	881,166	-----	881,166
1876.....	993,311	-----	993,311
1877.....	1,014,724	10,405	1,025,129
1878.....	1,030,986	96,597	1,127,583
1879.....	1,149,969	270,776	1,420,745
1880.....	1,379,725	592,288*	1,971,913
1881.....	1,581,215	728,858*	2,309,074
Total gross Tons.....	15,796,181	1,698,824	17,494,006

\* Includes Commonwealth and Florence Mines.

TABLE Showing the Amount of Land Plaster and of Calcined Plaster, produced in Michigan, for each year since 1866:

YEARS.	Land Plaster. Tons.	Stucco—Bbls. 300 lbs. each.
1866 .....	14,604	-----
1867 .....	17,439	-----
1868 .....	28,837	34,966
1869 .....	29,996	41,187
1870 .....	31,437	46,179
1871 .....	41,126	48,685
1872 .....	43,536	59,767
1873 .....	44,972	82,453
1874 .....	39,126	82,449
1875 .....	27,019	61,120
1876 .....	39,131	64,386
1877 .....	† 40,000	† 55,000
1878 .....	† 40,000	48,346
1879 .....	44,667	50,800
1880 .....	49,570	106,004
1881 .....	33,178	112,813
Total .....	562,618	894,155
For years previous to 1866 .....	† 100,000	† * 80,000
Total .....	62,618	974,155

† Partly estimated.

\* Stucco for years previous to 1868.

TABLE Showing the Number of Tons of Quartz Shipped from Lake Superior in 1881:

Name of Locality.	No. of tons.
Carp River .....	8,460
Lake Fairbanks .....	6,560
Total .....	15,020



TABLE Showing the Amount of Coal Produced in Michigan for 1877-78-79-80-81, Total for Previous Years Partly Estimated.

	Y'rs previ- ous to 1877.	1877.	1878.	1879.	1880.	1881.
Jackson mines.....	-----	67,697	61,785	65,000	-----	-----
Corunna mines.....	-----	-----	22,537	16,215	-----	-----
Other mines.....	-----	1,500	1,000	800	-----	-----
Stope Mine (Jackson Coal Co.).....	-----	-----	-----	-----	66,780	61,666
Eureka Mine (Jackson).....	-----	-----	-----	-----	30,000	37,477
Michigan Coal Co. (Jackson).....	-----	-----	-----	-----	20,021	23,987
Corunna Coal Co. (Corunna).....	-----	-----	-----	-----	12,252	7,000
Other localities.....	-----	-----	-----	-----	1,000	2,000
Total net tons.....	350,000	69,197	77,715	82,015	130,053	132,130

TABLE Showing the Amount of Land and Calcined Plaster Produced by the several Plaster Companies in Michigan for the Years Given.

NAME OF COMPANY.	Tons of Land Plaster.			Barrels of Stucco.		
	1879.	1880.	1881.	1879.	1880.	1881.
<sup>1</sup> Godfrey & Bro.....	9,117	9,000	6,422	-----	23,000	27,500
<sup>1</sup> Grand Rapids Plaster Co. ....	8,970	12,000	6,375	-----	23,500	20,400
<sup>1</sup> Geo. H. White & Co.....	1,900	-----	-----	-----	-----	-----
<sup>2</sup> Wyoming Mills Co.....	7,000	10,000	6,093	-----	-----	-----
<sup>2</sup> Union Mills Co.....	4,500	7,500	6,716	-----	35,000	34,913
<sup>1</sup> Taylor & McRingolds.....	10,585	9,570	6,572	-----	24,504	30,000
<sup>3</sup> Smith, Bullard & Co.....	1,586	1,500	1,000	-----	-----	-----
Total.....	44,667	49,570	33,178	-----	106,004	112,813

<sup>1</sup> Quarry, etc., at Grand Rapids.<sup>2</sup> Quarry, etc., at Grandville.<sup>3</sup> Quarry at Alabaster.



*Showing the Total Number of Net Tons of Refined Copper Produced by the Mines of Michigan. By Charles E. Wright, M. E., Commissioner of Mineral Statistics.*

<sup>1</sup> Mine in Ontonagon county. <sup>2</sup> Mine in Keweenaw county. <sup>3</sup> Mine in Houghton county. <sup>4</sup> Mine in Isle Royal county. <sup>5</sup> Mine in Houghton and Keweenaw counties. <sup>6</sup> Previous to 1855. <sup>†</sup> Now Flint Steel. <sup>a</sup> May 1st of the following year. <sup>b</sup> Consolidated with the Flint Steel River. <sup>d</sup> Consolidated with Pittsburg & Boston. <sup>f</sup> Sold to Phoenix company. <sup>g</sup> No returns. <sup>h</sup> Since 1865.





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